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**Offshore Environmental
Studies Program**

OCS Study
MMS 88-0087

Technical Summaries of Selected Pacific Region Final Reports

Volume 1

MMS

**Offshore Environmental
Studies Program**

OCS Study
MMS 88-0087

Technical Summaries of Selected Pacific Region Final Reports

Volume 1

Technical Summaries Prepared Under MMS Contracts
14-12-0001-30014 and 14-12-0001-30321 by:

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**U.S. Department of the Interior
Minerals Management Service
Offshore Environmental Assessment Division**

Washington, D.C.
1989

AVAILABILITY

The technical summaries contained in this OCS Study were prepared by Continental Shelf Associates, Inc. under contract to the Minerals Management Service (MMS). The summaries were compiled and prepared for publication by the MMS Branch of Environmental Studies located in Washington, D.C.

Copies of this publication can be obtained either from the MMS Office of Offshore Information and Publications or the Pacific OCS Regional Office. The addresses and telephone numbers for these offices are provided below. Questions about individual studies should be addressed to the Branch of Environmental Studies, MMS, Department of the Interior, 12203 Sunrise Valley Drive, Reston, VA 22091.

Technical Publications Unit
Minerals Management Service - MS 642
1951 Kidwell Dr., Suite 601
Vienna, VA 22180
(703) 285-2280
FTS *285-2280*

Pacific OCS Region
Public Affairs
1340 W. Sixth Street
Los Angeles, CA 90017
(213) 894-3389 or *894-2062*
FTS *798-3389* or *798-2062*

PREFACE

The Outer Continental Shelf (OCS) Environmental Studies Program, administered by the Minerals Management Service (MMS) of the U.S Department of the Interior since 1982, has sponsored hundreds of environmental and socioeconomic studies since its inception in 1973. Many of the research reports resulting from this program consist of several lengthy volumes. Most of the reports are available through the MMS Regional Offices, the National Technical Information Service, and regional libraries, but it is sometimes difficult and expensive to obtain the desired information. Therefore, the MMS initiated a project to summarize this vast collection of data and make the condensed information more readily available to potential users. These technical summaries will enable readers to determine whether they require the original reports. The technical summaries are anticipated to serve the purposes of many users of the information generated by the OCS Environmental Studies Program.

This volume represents the first collection of MMS technical summaries to be published. Summaries of 42 Pacific OCS Region final reports are included. Similar volumes will soon be published for the Alaska, Atlantic, and Gulf of Mexico Regions, and the Headquarters Office. Additional volumes will be published for the four MMS Regions and Headquarters Office as enough of the completed technical summaries become available.

The summaries are prepared following a standard format designed to provide the reader with a synopsis of administrative and technical information. A map is included when appropriate to show the area of study. In this volume, the summaries are organized in topical sections representing aspects of the OCS Environmental Studies Program. Topics include air quality, baseline studies, biology, endangered species, fates and effects (chemistry), physical oceanography, and socioeconomics.

Summarizing information contained in hundreds of lengthy "gray literature" reports is a major undertaking. Many individuals within the MMS contributed to this effort. In addition, under contract to the MMS, Continental Shelf Associates, Inc. (CSA) furnished a team of scientifically qualified technical writers and editors to produce the tightly written summaries contained in this volume. Their continued attention to detail has resulted in summaries that accurately characterize the scientific findings of the complex, and often lengthy, original reports. Mr. Brian Balcom, CSA Project Manager, has provided outstanding leadership throughout the term of this project and his responsiveness to the many changes requested by the MMS has been commendable. His high level of enthusiasm has contributed greatly to the success of this project.

HOW-TO-USE GUIDE

This volume contains 42 technical summaries of selected final reports prepared under contracts sponsored by the MMS Environmental Studies Program in the Pacific OCS Region. The technical summaries are organized in seven topical sections. Within topical sections the summaries are organized chronologically by access number (abbreviated contract numbers). During the period 1973 to 1978, when the Environmental Studies Program was administered by the Bureau of Land Management, contract numbers included the prefixes CT (contract), IA (Interagency Agreement), and MOU (Memorandum of Understanding). The MMS contract numbers are represented by their final 5 digits. Access numbers that include decimals indicate that an individual contract produced a number of final reports that resulted in the preparation of more than one technical summary. In this volume, for example, access numbers 29079 through 29079.8 demonstrate that MMS contract number 14-12-0001-29079 produced several final reports that resulted in eight separate technical summaries.

Three indexes are provided in this publication to assist the reader. The Key Word Index is an alphabetized listing, with reference to applicable access numbers and topical sections, of all key words contained in the technical summaries. The Report Title Index provides an alphabetized listing of report titles included in this collection of technical summaries with reference to page numbers. The Affiliation Index is an alphabetized listing of the project managers' affiliations, also with reference to page numbers. This index was prepared to provide the reader with a quick reference to the organizations responsible for managing the studies sponsored by the OCS Environmental Studies Program.

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INTRODUCTION

The OCS Environmental Studies Program was initiated in 1973 to support the U.S. Department of the Interior's offshore oil and gas leasing program. Statutory authorization is derived primarily from three laws: the 1953 OCS Lands Act, the 1969 National Environmental Policy Act (NEPA), and the OCS Lands Act Amendments of 1978. The OCS Lands Act established Federal jurisdiction over the submerged lands of the continental shelf seaward of State boundaries. The Act charges the Secretary of the Interior with responsibility for administering mineral exploration and development on the OCS. Originally, the Secretary designated the Bureau of Land Management (BLM) as the administrative agency for leasing submerged federal lands, and the Geological Survey for supervising exploration, development, and production. All Federal OCS minerals leasing and management activities were reorganized in the Minerals Management Service (MMS) by Executive Order 3071, enacted in January 1982, and amended in May 1982. The functions and mission of the OCS Environmental Studies Program, formerly a part of the BLM, are now a part of the MMS.

The enactment of NEPA in 1969 required all Federal agencies to use a systematic, interdisciplinary approach that ensures the integrated use of natural and social sciences in planning and decisionmaking for any Federal action or program that may have a significant impact on the environment. The BLM's response to this mandate assumed the form of comprehensive Environmental Impact Statements based upon information compiled during the various phases of the leasing process. In 1973, the BLM established the OCS Environmental Studies Program to assure that an adequate information base was available upon which sound management decisions could be made.

The OCS Lands Act Amendments of 1978 established policy for management of OCS oil and gas activities and for the protection of marine and coastal environments. They also provided the first legislative mandate for environmental studies in support of offshore minerals development. The OCS Lands Act Amendments of 1978 formally recognized the OCS Environmental Studies Program and required that studies commence at least 6 months prior to anticipated lease offering dates. The goal of the OCS Environmental Studies Program, as established by this Act, is to provide information needed for prediction, assessment, and management of impacts on the human, marine, and coastal environments of the OCS and nearshore areas that may be affected by OCS oil and gas activities. Three specific objectives are recognized to meet this goal. They are as follows: to establish information needed for the assessment and management of environmental impacts on the human, marine, and coastal environments of the OCS and potentially affected coastal areas; to predict impacts on marine organisms which may result from chronic low-level pollution or large spills associated with OCS production, from discharge of drilling muds and cuttings, pipeline emplacement, and from onshore development; and to monitor human, marine, and coastal environments to provide time-series and data-trend information for identification of significant changes in the quality and productivity of these environments.

From 1973 to 1978 the OCS Environmental Studies Program consisted primarily of baseline and monitoring studies. The design of these studies was based upon information assembled through literature syntheses and supplemented by special studies of selected sites or topics of interest. The baseline studies were large-scale multidisciplinary projects designed to characterize the nature, abundance, and diversity of marine animal and plant populations, the physical characteristics of the seafloor and overlying waters, and the concentrations of certain trace metals and hydrocarbons in the water, sediment, and selected organisms prior to any OCS oil and gas activity in an area. A series of monitoring studies, in concept, were to follow each baseline study to provide information on changes in measurable environmental characteristics relative to the baseline data as OCS oil and gas activities proceeded.

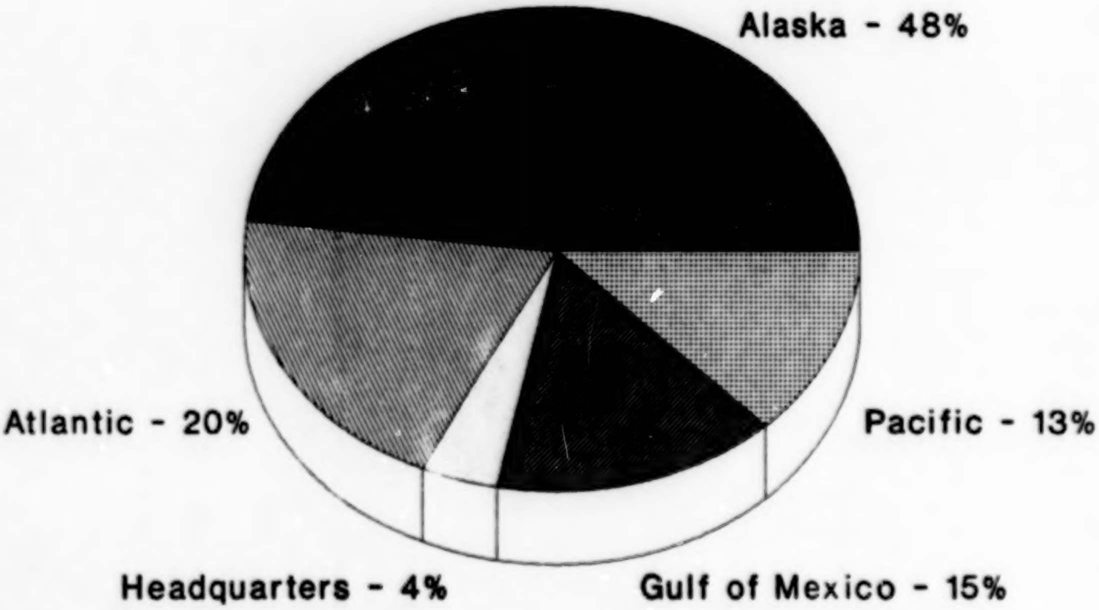
The baseline approach was criticized by decisionmakers because the program was not providing timely and appropriate information for leasing decisions, and by scientists who advised that the marine environment is too variable for a statistically valid baseline to be determined within a reasonable length of time. A major effort was undertaken to restructure the OCS Environmental Studies Program. Information needs of the OCS minerals management decisionmaking process became the thrust of environmental studies planning. A program management document entitled "Study Design for Resource Management Decisions: OCS Oil and Gas Development and the Environment" was published in October 1978. Program guidance presented in this document requires a clear relation between a study and OCS issues and decisions. The Environmental Studies Program continued to evolve with changes evident by a greater balance between prelease and postlease studies, a greater emphasis on generic studies, and development of postlease monitoring studies.

The initial funding of the OCS Environmental Studies Program in 1973 was just over $300,000. The program is now one of the largest, single agency, mission-oriented oceanographic programs in the Federal Government. Approximately $450 million have been invested in environmental and socioeconomic studies through fiscal year (FY) 1987. The following figure provides information on the allocation of funds from FY 1973 through FY 1987 for the four OCS Regional Offices and the Headquarters Office. The following table summarizes the expenditures by study topic for the same time period.

Information generated through the OCS Environmental Studies Program is received in the form of reports, maps, magnetic media, or other records. This represents a significant source of information needed for the many stages of the decisionmaking process involved in management of OCS resources. Such information is used for development of programmatic Environmental Impact Statements upon which the 5-year OCS oil and gas leasing schedules are based, for development of lease sale Environmental Impact Statements and other NEPA documents, for evaluation of plans for OCS exploration and development submitted by oil companies, and for planning other studies needed by the MMS. In addition, the information produced by the OCS Environmental Studies Program has many other users in State and Federal agencies, academic institutions, and private industry.

To make the vast collection of information more readily available to a wider audience, the MMS initiated a project to prepare technical summaries of all final reports prepared for the OCS Environmental Studies Program. This volume, containing 42 technical summaries of selected Pacific OCS Region final reports, is the first of several planned preliminary releases of summary information. Similar volumes will be published for the Alaska, Atlantic, and Gulf of Mexico Regions, and the Headquarters Office. As adequate numbers of technical summaries are completed, additional preliminary release volumes for each office are anticipated. When technical summaries of all final reports sponsored by the OCS Environmental Studies Program are completed, final summary publications will be prepared on a topical and/or regional basis. Current MMS contractors are required to prepare a technical summary for each final report. These summaries will be compiled and published on a periodic basis.

Figure 1 -- Environmental Studies Program - funding by region fiscal years 1973 - 1987 *



Total funding 1973-1987 -- $453,513,811

* *Percentages may not sum to 100 because of rounding.*

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OCS Environmental Studies Program

All Regions
Expenditures by Study Topic and Fiscal Years 1973-1987

[millions of dollars]

Topic	fiscal year 1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Total
Baseline	0.28	1.19	10.83	16.27	15.30	2.13	1.17	1.15	2.13	1.05	0.35	0.00	0.00	0.00	0.00	51.85
Air Quality	0.00	0.00	0.00	0.00	0.13	0.03	0.17	0.50	0.26	0.68	0.07	0.32	0.29	1.17	0.21	3.84
Biology	0.00	0.05	3.04	14.52	9.13	12.44	12.15	10.04	5.48	4.72	9.80	10.51	9.29	8.26	8.07	117.51
Endangered Species	0.00	0.00	0.19	0.28	0.56	2.67	2.34	4.39	3.89	4.82	5.61	2.67	5.50	2.29	1.62	36.82
Fates and Effects	0.00	0.00	1.33	3.33	3.87	4.85	1.83	5.00	2.94	3.72	3.06	2.52	1.13	0.95	2.07	36.61
Geology	0.00	0.00	3.67	5.31	6.26	7.13	6.28	12.35	10.10	3.96	1.17	1.14	0.94	0.18	0.15	61.66
Physical Ocean-ography	0.00	0.00	1.82	10.01	8.33	9.44	4.14	7.00	8.36	8.76	10.32	8.47	6.97	8.10	6.81	98.53
Social/ Economics	0.04	0.12	0.45	1.26	0.73	2.12	3.03	1.95	1.60	1.67	1.97	2.24	0.91	2.20	1.55	21.82
Other	0.05	0.03	2.76	1.62	0.48	0.10	0.18	2.35	2.75	1.57	1.19	0.91	1.27	2.33	2.37	19.97
Total	0.37	1.38	24.08	55.59	44.81	40.92	31.30	44.72	37.51	30.95	33.55	28.78	26.29	25.48	22.86	448.60

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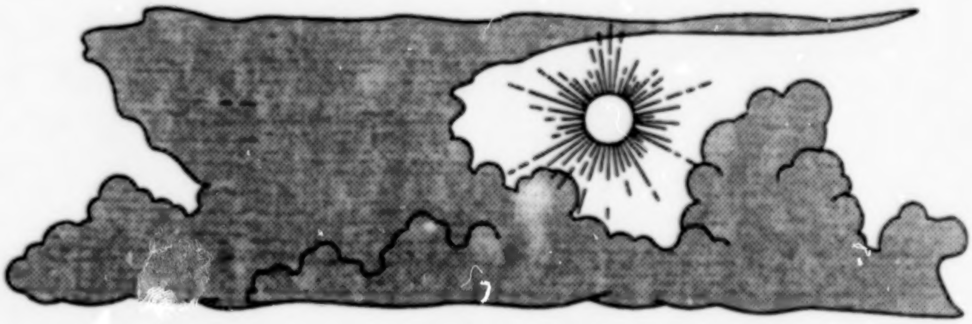
* *Numbers may not sum to totals because of rounding.*

Air Quality



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ACCESS NUMBER: **29101**

STUDY TITLE: Southern California Air Quality Model Validation.

REPORT TITLE: Southern California Offshore Air Quality Model Validation Study.

CONTRACT NUMBER(S): BLM: CT0-56; MMS: 14-12-0001-29101.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1980; 1981.

COMPLETION DATE OF REPORT: September 1981.

COST(S): FY 1980: $268,724; FY 1981: $2,000; CUMULATIVE PROJECT COST: $270,724.

PROJECT MANAGER(S): P. Zannetti.

AFFILIATION: AeroVironment Inc.

ADDRESS: 145 Vista Avenue, Pasadena, California 91107.

PRINCIPAL INVESTIGATOR(S)*: R. Baxter, D. Wilbur.

KEY WORDS: Southern California; air quality; modeling; dispersion; meteorology; seasonality; coastal zone; gas chromatography.

BACKGROUND: The Minerals Management Service (MMS) is responsible for assessing impacts of oil and gas development on onshore air quality. The MMS is also responsible for permitting and regulating air emissions on the Pacific Outer Continental Shelf (OCS) associated with oil and gas development. Interim guidelines have been established by the U.S. Geological Survey for use of atmospheric dispersion models to calculate air quality impacts. Unfortunately, most of the available models have been developed and calibrated from emissions released onshore. Due to the smoothness of their surface and their differing thermal capacity with respect to land, large bodies of water can lead to dispersion characteristics quite different from those over land. Very little research has addressed the problem of dispersion over water and at the land/sea interface of a low-elevation emission generated several kilometers offshore.

OBJECTIVES: (1) To provide a complete and detailed data base for understanding the problem of dispersion over water and at the land/sea interface by collecting meteorological data and establishing three-dimensional tracer gas concentration fields; (2) To test existing modeling approaches, in particular the Gaussian model, to evaluate their ability to simulate the particular dispersion conditions present in the Santa Barbara Channel area; (3) To make simple modifications to existing modeling techniques to better "fit" experimental data, and therefore to adapt them to the unique dispersion conditions of the Santa Barbara Channel area; and (4) To recommend guidelines for applying air quality models to similar dispersion problems in the future.

DESCRIPTION: The study included both field experiments and analysis. Field experiments were performed in September 1980 and January 1981, characteristic of summer and winter meteorological conditions, respectively. A tracer gas, sulfur hexafluoride (SF_6), was released at a known rate (50 lb h^{-1} for 6 h) from a vessel anchored several kilometers offshore. Ambient tracer gas concentrations were measured both horizontally (across wind) and vertically at each of three downwind distances [0.8 km (0.5 mi) offshore, inland close to the coastline, and inland about 6 km (4 mi)]. Meteorological data were collected concurrent with tracer measurements as a means of establishing the conditions under which the tracer gas was transported and diffused. A network of meteorological instruments at the land surface, sea surface, and aloft were employed. Aboard the vessel, wind speed and direction, wind fluctuation, speed, direction, temperature, and dew point were measured at heights of 7 and 20.5 m above the sea surface. Measurements aloft included: the use of two tethered balloons over land, which measured wind speed and direction, temperature, and wet bulb temperature; the use of free-rise balloons during periods of high winds or extensive cloud cover when the tethered balloons could not be employed; the use of an acoustic sounder to measure wind speed continuously; and the use of an instrumented research aircraft over land and water to measure temperature, dew point, turbulence, and the optical scattering coefficient. Acoustic radar was also used offshore on the vessel to remotely monitor changes in the mixed layer depth and the height of inversion. Measurements were made twice daily for temperature and humidity profiles in the lower 1,500 m of the atmosphere. Upon release of the tracer gas, air samples were collected at a number of fixed locations onshore using a combination of hourly average and instantaneous grab samples. In addition, two continuous SF_6 analyzers (one on the ground, one in the air) were used to traverse the plume. Offshore, grab samples were collected from a boat from two locations.

All grab samples were analyzed using an electron-capture gas chromatograph. The results of the field experiments provided data on the processes affecting dispersion over water and at the land/sea interface, and allowed computer dispersion model predictions to be compared with actual tracer measurements.

Several classification schemes were evaluated which, based upon measured meteorological parameters, divide atmospheric conditions into dispersion classes. Classes range from unstable (with significant horizontal and vertical dispersion rates)to stable (with little dispersion). The classification schemes which were analyzed included: (1) the Pasquill-Gifford (insolation) method—this system uses an estimate of the solar insolation at the surface to estimate a heat flux category; this plus the measured wind speed is used to determine the classification; (2) temperature variation with height; (3) horizontal wind direction variation; (4) vertical wind speed variation; and (5) a new method developed by the Naval Postgraduate School, Monterey, California.

SIGNIFICANT CONCLUSIONS: Study results indicated that, for the modeling approaches tested, none of the standard methods adequately classified dispersion of an offshore release in the Santa Barbara Channel area. Modification of the input data to the model, based on observed measurements in the field, can serve to improve the model results.

STUDY RESULTS: None of the classification schemes were totally applicable to the dispersion data collected in the field. In general, the horizontal wind direction variation approached classified dispersion in the horizontal field reasonably well, while the temperature variation with height method classified dispersion in the vertical plane reasonably well. The Pasquill-Gifford method can only be used to approximate ground-level concentrations. None of the standard methods which were evaluated classified dispersion in both planes adequately. Comparisons of field-based plume dispersion curves with literature values revealed considerable differences; specifically, horizontal plume dispersion was greater while vertical plume dispersion was considerably less than data found in the literature and in standard references. These variations were interpreted to mean that standard air quality dispersion modeling techniques would not accurately represent the dispersion processes operating over water and at the land/sea interface in the Santa Barbara Channel area. Consequently, another validation was performed after modifying the appropriate stability classes that would more closely match the observed dispersion characteristics. In doing so, values generated by the horizontal wind direction variation approach were used to calculate the horizontal stability class; values generated by the temperature variation with height approach were employed to calculate the vertical stability class. This modified approach provided the best "fit" to the field measurements and was consistent with current atmospheric turbulence hypotheses. Using this modified approach also resulted in the validation of a Gaussian dispersion model which can predict impacts onshore (i.e., at the shoreline) from emissions generated offshore (correlation coefficient = 0.71). For the purpose of calculating maximum ground level concentrations, the performance of the standard Gaussian model was compared with that of the modified Gaussian technique. The modified technique consists of changing some of the stability categories to conform with the observed data. The correlation coefficients were 0.40 and 0.53 for the standard and modified techniques, respectively. The experimental and modeling efforts summarized by this study are applicable only to releases at low emission heights (up to 30 m) or low enough to have a plume sufficiently vertically mixed in the marine layer before reaching the shoreline.

Study efforts were also directed at trajectory model validation, using tracer gas field measurements acquired during this study. The key problem of representing horizontal diffusion was noted and a practical scheme for future modeling applications was presented. It was suggested that point source trajectory modeling should preferably use an expanding cell (i.e., variable volume) to allow the cell to grow according to the actual plume size which would minimize the horizontal diffusion problem.

STUDY PRODUCT(S): Zannetti, P. D., M. Wilbur, and R. A. Baxter. 1981. Southern California Offshore Air Quality Model Validation Study. A final report by AeroVironment, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. Vol. I - NTIS No. PB82-190710; Vol. II - NTIS No. PB82-190729; Vol. III - NTIS No. PB83-149344. Contract No. AA851-CT0-56.

*P.I.'s affiliation may be different than that listed for Project Manager(s).

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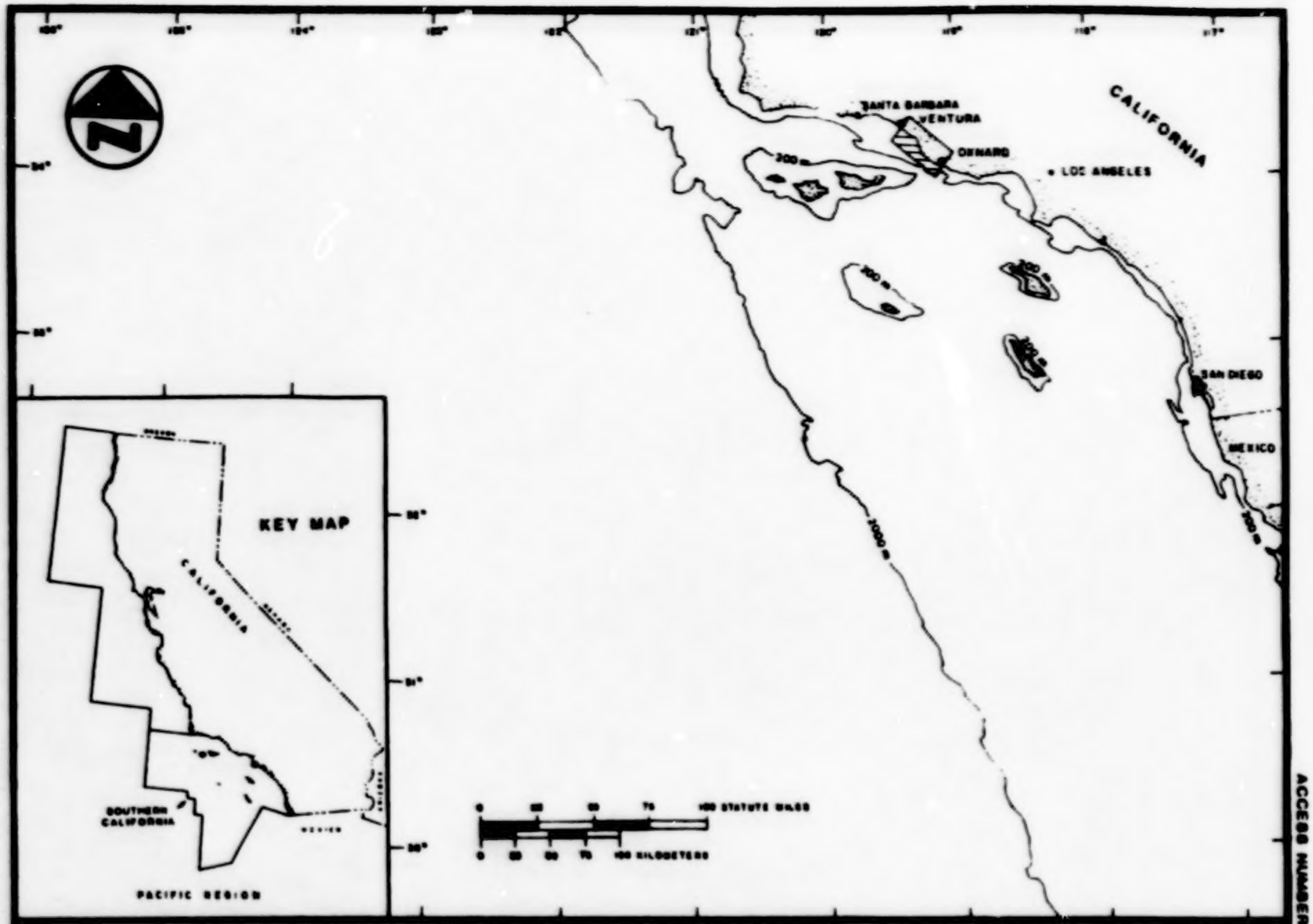

GEOGRAPHIC LOCATION OF THE STUDY AREA CHARACTERIZED AND EVALUATED METEOROLOGICALLY DURING THE SOUTHERN CALIFORNIA OFFSHORE AIR QUALITY MODEL VALIDATION STUDY.

ACCESS NUMBER: 29101

ACCESS NUMBER: 29101

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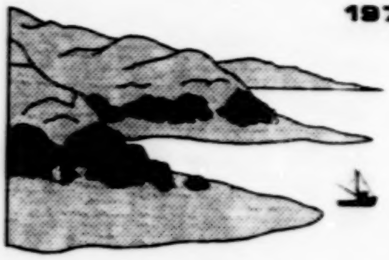
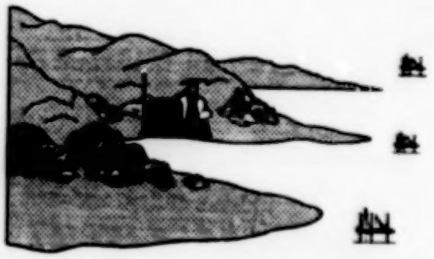
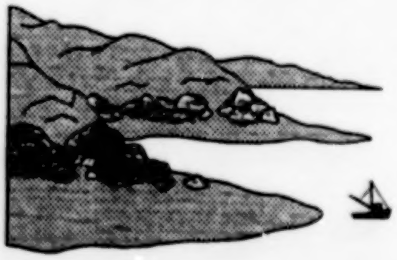
1973



Baseline





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ACCESS NUMBER: **29079**

STUDY TITLE: Southern California Bight Baseline, Year I.

REPORT TITLE: Southern California Baseline Study and Analysis 1975/1976
(Year I), Vol. I, Executive Summary.
Southern California Baseline Study and Analysis 1975-1976
(Year I), Vol. II, Integrated Summary Report.

CONTRACT NUMBER(S): BLM: CT5-52; MMS: 14-12-0001-29079.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1975; 1976.

COMPLETION DATE OF REPORT: March 1977 (Vol. I); March 1978 (Vol. II).

COST(S): FY 1975: $3,802,641; FY 1976: $127,623; CUMULATIVE PROJECT COST: $3,930,264.

PROJECT MANAGER(S): R. Callahan.

AFFILIATION: Science Applications, Inc.

ADDRESS: P.O. Box 2351, 1200 Prospect Street, La Jolla, California 92037.

PRINCIPAL INVESTIGATOR(S)*: R. Callahan, R. Shokes.

KEY WORDS: Southern California; Southern California Bight; Tanner-Cortes Banks; baseline; biology; synthesis; infauna; benthos; geochemistry; trace metals; hydrocarbons; spectrophotometry; community; gas chromatography; spectrometry; epifauna; intertidal; faunal zones; photographimetric technique; aerial photography; sediment.

BACKGROUND: The Southern California Baseline Study was a large multi-year, multidisciplinary marine program that was conducted to provide the U.S. Department of the Interior with information necessary to assess the potential environmental impacts of leasing tracts of submarine lands for commercial oil production and to properly manage marine resources if recovery of petroleum occurs. Studies within the program were designed to provide an overview of the Outer Continental Shelf (OCS) chemical, biological, and sedimentological regimes and a statistical baseline of the sand beach and rocky intertidal floral and faunal communities. The parts that are herein abstracted are the Year I Executive Summary (Volume I) and Integrated Summary Report (Volume II). Volume III consists of a series of detailed reports, each authored by 1 of 20 participating investigators.

OBJECTIVES: The objective of Volume I is: (1) To provide a summary of the scope, significant accomplishments and findings of the total Year I study in language suitable for a broad readership. The objectives of Volume II are: (1) To clearly delineate all methods and procedures; (2) To systematically describe the programs comprising the study; and (3) To interpret the significance of each individual report in light of the study as a whole.

DESCRIPTION: Benthic sampling was focused primarily in areas of high industry interest and was designed to allow coverage of the following five regions: inner shelf, inner basin, outer shelf, outer basin, and outer banks.

Geochemical sediment samples were collected at 145 stations using a Teflon-lined, slowed-entry, completely vented box corer. The top 1 cm on some samples was preserved for trace metals or hydrocarbons. Particle size distribution was determined by combination of pipette and automatic particle size analyzer. Clay mineralogy was determined by x-ray diffraction. Analytical methods for metals included atomic absorption spectrophotometry (flame and flameless) and neutron activation analysis; gas liquid chromotography supplemented by high resolution mass spectrometry was utilized for hydrocarbons.

Water samples for particulate metals and high molecular weight hydrocarbons were collected at 41 stations with a modified Bodega Bodman sampler.

Box corer, trawls, and dredges were used to collect macro- and microfauna. Most of the 711 box core samples were taken with a 0.063 m^2 Naval Electronics Laboratory spade corer having a camera attached; 145 trawl/dredge samples were taken.

Intertidal sampling methodology included undisturbed sampling (photographimetric), disturbed quadrat sampling, and aerial photo-survey (for kelp beds).

Sandy beach/slough sampling was conducted at 11 mainland locations and 6 island beach locations. Undisturbed data collection included beach profiling, bird and mammal counts, and noting debris and beach parameters. Disturbed sampling was conducted using single-line transects and random stratified quadrats.

SIGNIFICANT CONCLUSIONS: The distributions of petroleum related hydrocarbons and trace metals were characterized and found to vary substantially throughout the region. Animals from locations contaminated with petroleum or trace metals typically incorporated them into their tissues. Indicator species were selected for future studies. The composition of plant and animal communities was characterized and found to vary substantially throughout the region. Petroleum hydrocarbons can be measured at predevelopment concentrations and crude petroleum can usually be differentiated from other hydrocarbons, including refined oils. The Tanner-Cortes Banks region supports an unusual assemblage of shallow water and open ocean organisms. At least two uncommon organisms occur on these banks: a purple coral and a very primitive mollusc of the Order Monoplacophora. Significant improvements were made in collection, analyses, and interpretation of petroleum hydrocarbon and trace metal chemical data. These improvements allowed the reliable measurement of predevelopment concentrations of hydrocarbons and trace metals.

STUDY RESULTS: The nearshore environment is broadly contaminated with both refined and crude petroleum. Concentrations of trace metals fluctuate with location, exhibiting enrichments near areas of urban and industrial activity. Areas adjacent to nearshore seeps such as Coal Oil Point and San Pedro are extensively contaminated with crude oil and somewhat enriched in vanadium. Areas adjacent to urban outfalls such as Whites Point near Los Angeles are contaminated with petroleum products and metals such as lead, cadmium, chromium, and zinc. Nearshore areas not adjacent to outfalls or seeps do not appear extensively, if at all, contaminated by either petroleum or trace metals. However, chemical data from these areas are sufficient to distinguish them from the outer shelves. The nearshore basins appear to be the final residence for urban effluent materials and nearshore seeps. Sediment concentrations of petroleum and trace metals are elevated in these basins. The outer ridges and basins vary regarding petroleum and trace metal concentrations. Most stations near San Nicolas and San Miguel Islands, on Tanner and Cortes Banks and within the outer basins typically have very low concentrations of petroleum. Exceptions include certain areas contaminated by seeps of crude oil. Concentrations of trace metals in these outer areas reflect the complex fluxes natural to the marine environment. These fluxes do not appear to have been appreciably affected by human activity. Benthic macroinfauna off Southern California can be classified as belonging to nearshore, island, or open water groups. Each group is highly variable. Community structure within each group changes with water depth and sediment type. The rocky intertidal habitat is typically comprised of upper, middle, and lower zones throughout the Southern California area. No alterations in benthic community structure were discernable at stations heavily contaminated with petroleum, trace metals, or urban effluents. However, the ability to discern such changes was limited. Mainland rocky intertidal sites have fewer organisms and fewer kinds of organisms than similar island sites. Mainland organisms are also less vigorous than similar island forms. These changes appear to be due to chemical or physical stresses affecting mainland habitats. Crude oil appears to have altered the composition of the rocky intertidal plant communities at Coal Oil Point. Four communities of microinfauna (Foraminifera) live in the Southern California OCS. These communities occupy shallow water, slope, or basin habitats. All offshore infaunal communities are impoverished in areas of active sediment transport or deposition. Seasonal changes in rocky intertidal community structure are slight. Five devices for collecting uncontaminated water and uncontaminated and undisturbed sediment samples suitable for chemical analyses were either developed or redesigned from existing devices. The use of such state-of-the-art equipment has demonstrated the practicability of obtaining a chemical data base of sufficient size and quality to resolve regional differences in the chemistry of the Southern California Bight. Analytical methodologies were developed which allowed the discrimination of petroleum type hydrocarbons from other hydrocarbons.

STUDY PRODUCT(S): Callahan, R. A. and R. Shokes. 1977. Southern California Baseline Study and Analysis 1975/1976 (Year I), Vol. I, Executive Summary. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB290739/AS. Contract No. 08550-CT5-52. 35 pp.

Shokes, R. E. and R. A. Callahan. 1978. Southern California Baseline Study and Analysis 1975-1976 (Year I), Vol. II, Integrated Summary Report. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB290739/AS. Contract No. 08550-CT5-52. 439 pp.

*P.I.'s affiliation may be different than that listed for Project Manager(s).

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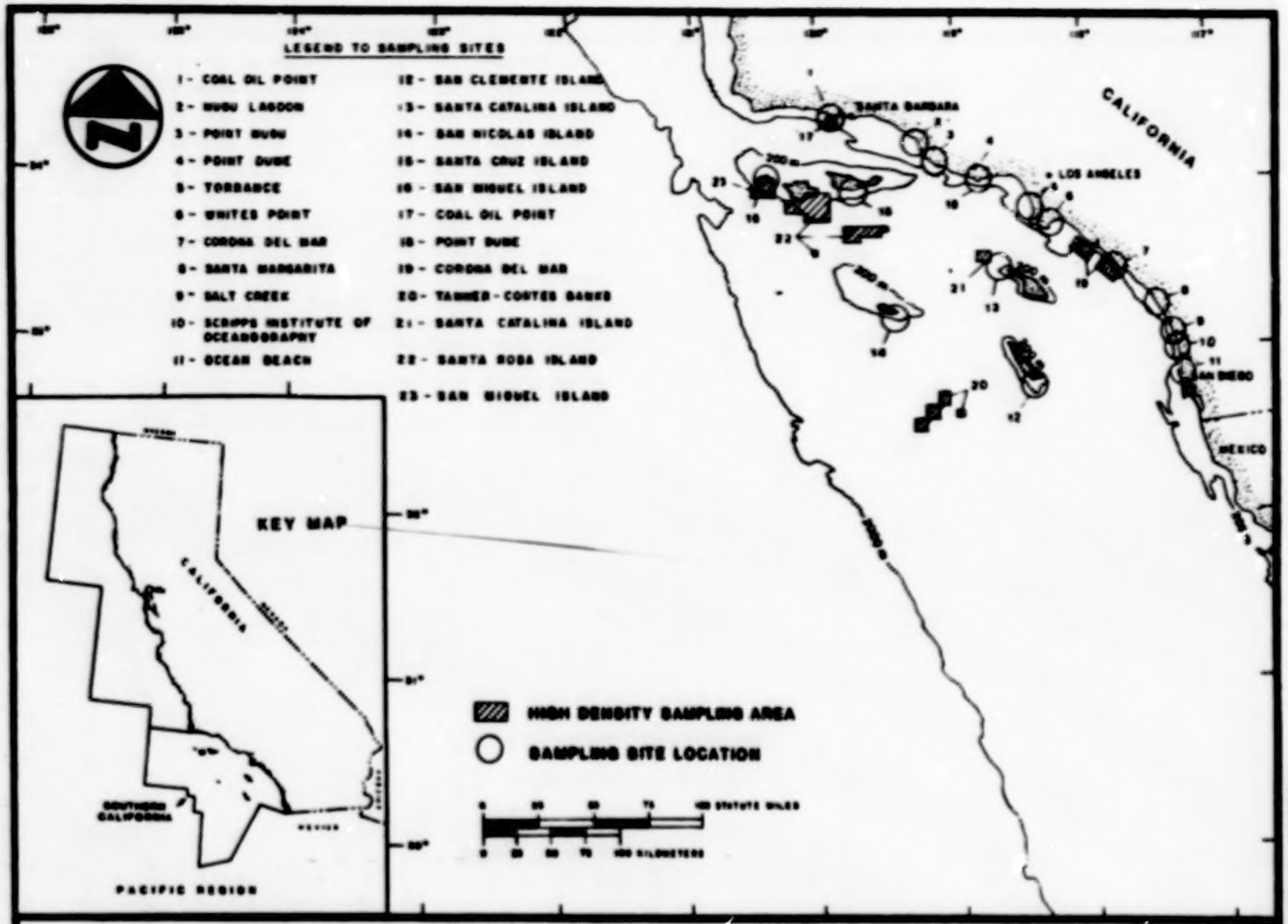

SAMPLING SITE LOCATIONS FOR THE SOUTHERN CALIFORNIA BASELINE STUDY, YEAR II.

ACCESS NUMBER: **29079.2**

STUDY TITLE: Southern California Bight Baseline, Year I.

REPORT TITLE: Southern California Baseline Study Intertidal and Benthic 1975-1976 (Year I), Vol. III, Report 1.1 - Collection Techniques for Benthic Sediment Samples; Report 1.2 - Sediment Characterization and Analysis.

CONTRACT NUMBER(S): BLM: CT5-52; MMS: 14-12-0001-29079.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1975; 1976.

COMPLETION DATE OF REPORT: March 1978.

COST(S): FY 1975: $3,802,641; FY 1976: $127,623; CUMULATIVE PROJECT COST: $3,930,264.

PROJECT MANAGER(S): R. Callahan.

AFFILIATION: Science Applications, Inc.

ADDRESS: P.O. Box 2351, 1200 Prospect Street, La Jolla, California 92037.

PRINCIPAL INVESTIGATOR(S)*: P. Fischer, A. Soutar.

KEY WORDS: Southern California; Southern California Bight; baseline; sediment; grain size; mineralogy; geochemistry.

BACKGROUND: The Southern California Baseline Study was a large multi-year, multidisciplinary marine program that was conducted to provided the U.S. Department of the Interior with information necessary to assess the potential environmental impacts of leasing tracts of submarine lands for commercial oil production and to properly manage marine resources if recovery of petroleum occurs. The parts that are herein abstracted are the results of the first year of study concerning: (1) collection techniques for benthic sediment samples; and (2) sediment characterization and analysis.

OBJECTIVES: (1) To develop and augment guidelines for collection techniques of benthic sediment samples; (2) To document results of sediment analysis for 1,044 samples from the Southern California Bight based on grain size, carbonate and carbon content, and clay mineralogy.

DESCRIPTION: Samples for sediment analyses were subsampled from core samples collected using a modified Naval Electronics Laboratory box corer. Pertinent data on sampling location, time of collection, bottom depth, etc. were not given in the report. These types of data are given in a separate report for the total study.

Fine grain analysis of surficial sediment (top 5 cm) was performed by pipette analysis. The coarse fraction analyses were accomplished using an automatic particle size analyzer. Grain size distributions were reported in phi units. Data presented included average or graphic mean size, sorting by standard deviation, graphic skewness, and graphic kurtosis. Carbonate and carbon determinations were made utilizing a modified Bien gasometric digestion assembly coupled with a total carbon analyzer. Clay mineralogy was determined on the < 4 phi size sediment fractions. Samples were washed with distilled water and analyzed by x-ray diffraction using the smear technique.

Data were subjected to factor and trend analysis. This was accomplished by fitting a trend function to a set of data values usually by the method of least squares.

SIGNIFICANT CONCLUSIONS: Clay mineral samples are of detrital origin, with the adjacent continental regions of the Channel Islands serving as source areas. The smectite group of clays and illite dominate the clay mineralogy of the surficial sediments. Kaolinite increases in a southerly direction along the inner margin of the borderland. Chlorite is unusually high in the vicinity of Santa Catalina Island and nowhere else on the Southern California continental shelf. Trends indicate a general increase in carbonate from north to south, and from inner shelves to the outer banks. Shelf values of organic carbon are normally less than 1%; values up to 3.5% off Coal Oil Point are considered to be due to natural seeps.

STUDY RESULTS: Existing sediment samplers were investigated and some were modified to meet requirements for geochemical sampling. These modifications included venting to prevent back pressure, and constructing the device out of noncontaminating materials such as aluminum. Modifications and collection techniques were given for three types of samplers: geochemical box corer; Van Veen geochemical grab; and Soutar/Van Veen geochemical grab. Procedures for subsampling the above devices were enumerated. Illustrations for specialized sampling scoops and templates were shown and described. All 145 of the samples required were collected and 60% of these were judged, based on quality of recovered sample, to be very good to excellent. Of the 145 samples, 65 were collected in fine sediments with the box corer and required 103 drops. The Van Veen grab was used for 8 samples in coarse sediment and required 26 drops. The Soutar/Van Veen grab was used for 72 samples in coarse sediment and required 130 drops.

The clay mineralogy of the region is not unusual considering the geology, climate and climatic history of the contiguous continent. In all respects, the modern benthic clay minerals are practically indistinguishable from their counterparts in the soils of the mainland and the offshore islands. In general, the smectite group of clays (montmorillonite, vermiculite, etc.) and illite dominate the surficial sediments. This is considered normal as the source is subjected to weathering under arid and semiarid conditions. Kaolinite occurs in small amounts throughout the study area and increases in a southerly direction along the borderland. This reflects the distribution of its source, the Eocene palosol. A highly crystalline magnesium-rich chlorite is present in high quantities (often in excess of 20%) in the vicinity of Santa Catalina Island. It clearly originates from the chlorite-rich Catalina Schist which occurs on Santa Catalina Island. In the offshore regions, the dominant regional control of clay mineral distribution is clearly the Southern California Counter Current. In the nearshore region, the distribution is under many controls but flocculation may dominate local distribution.

The increasing calcareous content of the beaches from north to south (1.3 to 3.7%) is primarily controlled by warming temperatures to the south. The increase of carbonate content with depth in the inner and middle basins results from slower rates of detrital sedimentation in deep water further from the mainland. The increase in carbonate content of the island beaches to 16% is due to a lack of abundant detrital sediments.

Total organic carbon (TOC) values are inversely related to the mean grain size and silt-clay content. Highest TOC values are near the center of the basins where slow rates of sedimentation and limited biogenic activity occur. Highest values not attributed to the latter may result from effluent outfalls.

STUDY PRODUCT(S): Soutar, A. 1978. Collection Techniques for Benthic Sediment Samples. In: Southern California Baseline Study Intertidal and Benthic 1975-1976 (Year I), Vol. III, Report 1.1. A final report for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB80-218001/AS. Contract No. 08550-CT5-52. 148 pp.

Fischer, P. 1978. Sediment Characterization and Analysis. In: Southern California Baseline Study Intertidal and Benthic 1975-1976 (Year I), Vol. III, Report 1.2. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB80-218001/AS. Contract No. 08550-CT5-52. 114 pp.

*P.I.'s affiliation may be different than that listed for Project Manager(s).

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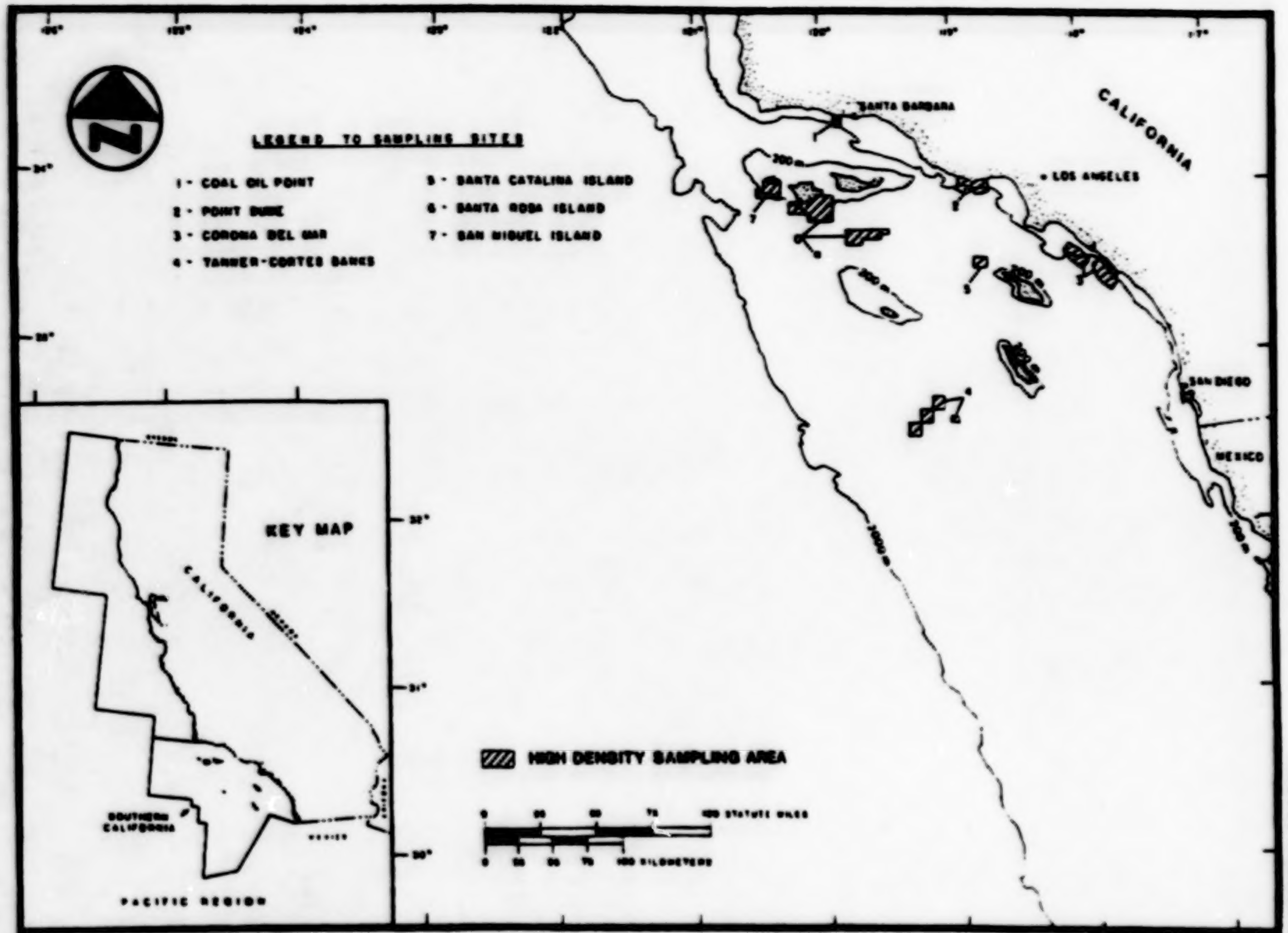

SAMPLING SITE LOCATIONS FOR THE SOUTHERN CALIFORNIA BASELINE STUDY, YEAR II.

ACCESS NUMBER: 29079.2

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ACCESS NUMBER: **29079.3**

STUDY TITLE: Southern California Bight Baseline, Year I.

REPORT TITLE: Southern California Baseline Study, Intertidal and Benthic 1975-76 (Year I), Vol. III, Report 2.1 - Spatial and Temporal Variations in the Distribution and Abundance of Rocky Intertidal and Tidepool Biotas in the Southern California Bight.

CONTRACT NUMBER(S): BLM: CT5-52; MMS: 14-12-0001-29079.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1975; 1976.

COMPLETION DATE OF REPORT: March 1978.

COST(S): FY 1975: $3,802,641; FY 1976: $127,623; CUMULATIVE PROJECT COST: $3,930,264.

PROJECT MANAGER(S): R. Callahan.

AFFILIATION: Science Applications, Inc.

ADDRESS: P.O. Box 2351, 1200 Prospect Street, La Jolla, California 92037.

PRINCIPAL INVESTIGATOR(S)*: M. Littler.

KEY WORDS: Southern California; Southern California Bight; baseline; biology; intertidal; photographimetric technique; community; macrophytes; recovery; seasonality; faunal zones.

BACKGROUND: The Southern California Baseline Study was a large multi-year, multidisciplinary marine program that was conducted to provide the U.S. Department of the Interior with information necessary to assess the potential environmental impacts of leasing tracts of submarine lands for commercial oil production and to properly manage marine resources if recovery of petroleum occurs. Studies within the program were designed to provide an overview of the Outer Continental Shelf (OCS) chemical, biological, and sedimentological regimes and a statistical baseline of the sand beach and rocky intertidal floral and faunal communities. The study section herein abstracted is only a part of the Year I study. The present section investigates the rocky intertidal communities in the vicinity of four mainland and six insular (island) sites.

OBJECTIVES: (1) To establish quantitatively reliable and reproducible baseline assessments of natural variations in the distribution and abundance of rocky intertidal organisms at selected regions of the Southern California Bight; and (2) To relate variations to possible causal mechanisms.

DESCRIPTION: The 10 study sites included Coal Oil Point, Whites Point, Corona del Mar, and Ocean Beach along the mainland coast, as well as insular sites on San Clemente, Santa Catalina, Santa Barbara, San Nicolas, Santa Cruz, and San Miguel Islands. All sampling sites were visited quarterly beginning May 1975 and ending April 1976.

The principal method of sampling the standing crops of intertidal organisms was a photographimetric technique of undisturbed sampling which yields parallax-free samples that can be used to generate precisely detailed and highly reproducible quantitative information (i.e., cover, number of individuals per unit area, and the percentage of sample plots in which a given species occurs). The method is rapid, simple, and also depicts the status of the biota. Two to four belt transects, 4 to 70 m apart, were laid perpendicular to the waterline from above the highwater mark to just below the water line at low tide. The upper end was permanently marked for return sampling. Each quadrat was photographed with color and infrared 35-mm film.

Approximately 40 samples (quadrats) were taken along each belt. Nonpermanent disturbed quadrats were selected near undisturbed quadrats and harvested using scrapers. Quadrats were 0.15 and 1.0 m^2 for small and large organisms, respectively.

Laboratory analyses included identification; enumeration; and wet, dry, and ash-free biomass. Data analyses consisted of listing parameter determined vs. transect or zone and calculation of various species diversity indices. Seasonal changes in abundances of populations and zonal regions were statistically compared using modified discriminant analysis techniques.

SIGNIFICANT CONCLUSIONS: The rocky intertidal habitat is typically comprised of upper, middle, and lower zones throughout the Southern California area.
Mainland rocky intertidal sites have fewer organisms and fewer kinds of organisms than similar island sites. Site-specific variations tend to overshadow any seasonal trends.

STUDY RESULTS: In all, 477 taxa were identified at the 10 sites. Over half of the plant species were red algae and most of the animals were gastropod molluscs. Assemblages of organisms were found to be site-specific.

The sites tend to fall into two groups: island sites and mainland sites. This overall trend appears to be due to a lower level of human-induced stress on the island sites. Island sites tend to have higher biomass standing crop than mainland sites. This difference is primarily due to the brown algal standing crop which is more sparse and patchy at the mainland sites. The data suggest that reduction in brown algal biomass may be associated with sewage-induced stress. The number of macrophytes (large algae such as kelp) unique to the islands is much higher than the number found only on the mainland. Also, there are many more macroinvertebrates unique to the islands than to the mainland. These observations suggest that the floral and faunal communities on the mainland have been reduced due to environmental stress although this is predicated on the assumption that at some previous time the island and mainland environments had similar biological compositions. Of the algae which occur at the other mainland sites, 66% of these do not occur at Whites Point and 50% do not occur at Coal Oil Point. In addition at Coal Oil Point, nine algal taxa were found which occur nowhere else. This suggests that the presence of oil from local seeps at Coal Oil Point may eliminate many ubiquitous macrophyte species and in doing so creates a habitat for otherwise noncompetitive and, therefore, less common forms. The data from Whites Point suggest that the nearby sewage outfall has eliminated many algal taxa which appear ubiquitously at the other mainland sites.

Overall, the evidence gathered in this study indicates the following environmental factors as most closely associated with the biological variations in the rocky intertidal environment: (1) Urban wastes and other forms of human impact (trampling, sampling); (2) Natural environmental stresses, such as wave surge, unstable substrate, natural oil seeps; (3) Habitat variability, primarily in substrate type, roughness, slope, and height above low water; and (4) Ambient water temperature range (related to latitudinal geographic location).

ACCESS NUMBER: **29079.3**

STUDY PRODUCT(S): Science Applications, Inc. 1978. Southern California Baseline Study Intertidal and Benthic 1975-76 (Year I). Vol. III, Report 2.1 - Spatial and Temporal Variations in the Distribution and Abundance of Rocky Intertidal and Tidepool Biotas in the Southern California Bight. A final report for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. Chapters 1 to 8 - NTIS No. PB80-218019/AS; Chapters 9 to 12 - NTIS No. PB80-218027/AS. Contract No. 08550-CT5-52. 1025 pp. + app.

The previous citation represents a compendium of reports (chapters), each authored separately and covering a unique topic or area. Specific report numbers and titles, accompanied parenthetically by the respective author(s), are as follows:

Spatial and Temporal Variations in the Distribution and Abundance of Rocky Intertidal and Tidepool Biotas in the Southern California Bight-General Introduction, Methods and Materials. Chapter 1 (Litter, M. M.).

Biological Features of Rocky Intertidal Communities Near Corona del Mar, California. Chapter 2 (Littler, M. M.).

Biological Features of Rocky Intertidal Communities Near Fisherman Cove, Santa Catalina Island, California. Chapter 3 (Murray, S. N. and M. M. Littler).

Biological Features of Rocky Intertidal Communities Near Cave Canyon, Santa Barbara Island, California. Chapter 4 (Seapy, R. R. and M. M. Littler).

Biological Features of Rocky Intertidal Communities at Coal Oil Point, Santa Barbara Island, California. Chapter 5 (O'Brien, P. Y. and M. M. Littler).

Biological Features of Rocky Intertidal Communities Near Ocean Beach, San Diego, California. Chapter 6 (Seapy, R. R. and M. M. Littler).

Biological Features of Rocky Intertidal Communities Near Whites Point, Los Angeles, California. Chapter 7 (Murray, S. N. and M. M. Littler).

Biological Features of Rocky Intertidal Communities Near Dutch Harbor, San Nicolas Island, California. Chapter 8 (Littler, M. M. and P. Y. O'Brien).

Biological Features of Rocky Intertidal Communities Near Willows Anchorage, Santa Cruz Island, California. Chapter 9 (Seapy, R. R. and M. M. Littler).

Biological Features of Rocky Intertidal Communities Near Cuyler Harbor, San Miguel Island, California. Chapter 10 (Littler, M. M. and P. Y. O'Brien).

Biological Features of Rocky Intertidal Communities on Leeward San Clemente Island, California. Chapter 11 (Murray, S. N. and M. M. Littler).

Summary. Chapter 12 (Littler, M. M.).

*P.I.'s affiliation may be different than that listed for Project Manager(s).

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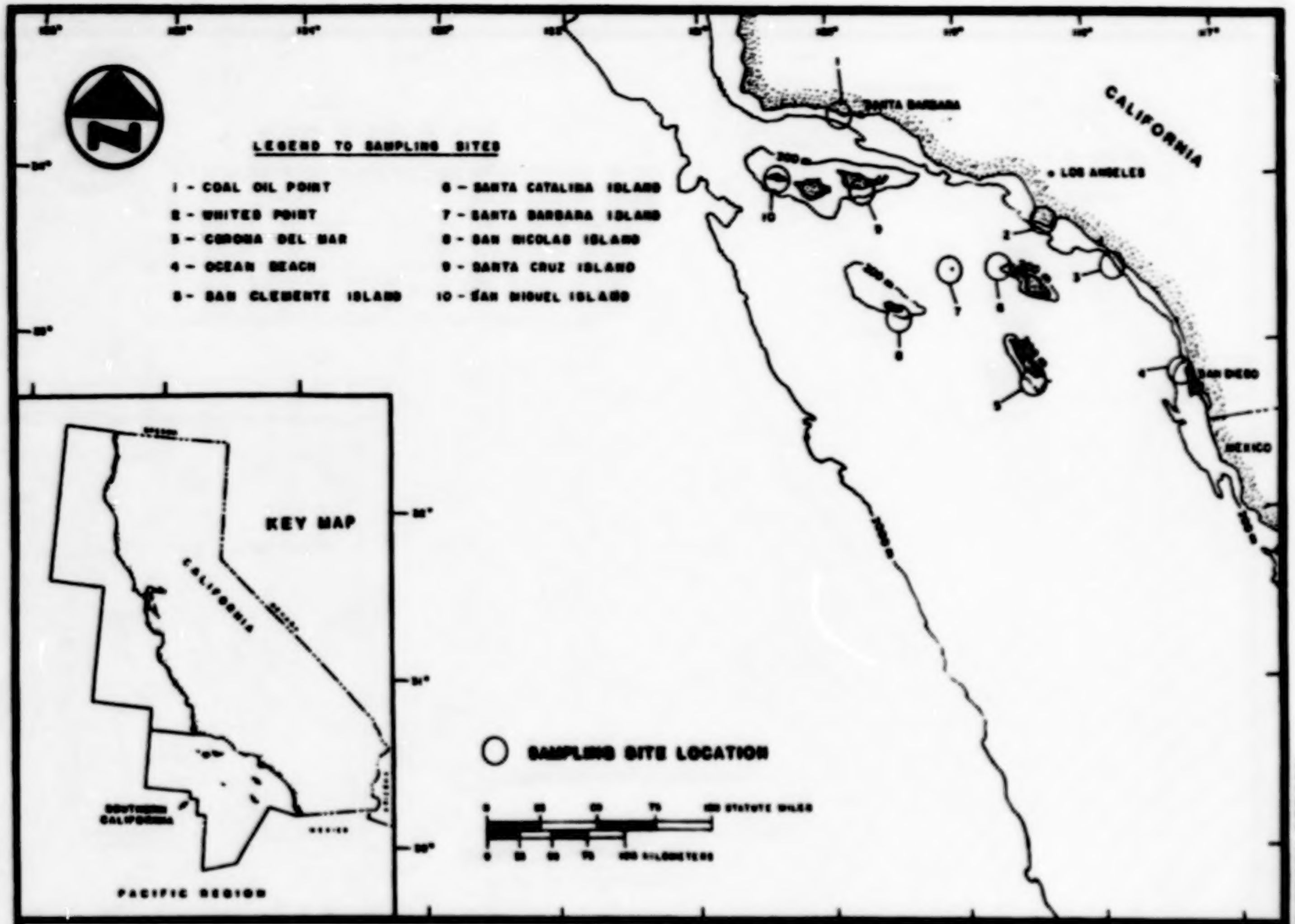

SAMPLING SITE LOCATIONS FOR THE SOUTHERN CALIFORNIA BASELINE STUDY, YEAR I .

ACCESS NUMBER: 29079.3

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ACCESS NUMBER: **29079.4**

STUDY TITLE: Southern California Bight Baseline, Year I.

REPORT TITLE: Southern California Baseline Study Intertidal and Benthic 1975-76 (Year I), Volume III, Reports 2.2 - Mussel Community Study; Report 2.3 - Sandy Beaches and Sloughs.

CONTRACT NUMBER(S): BLM: CT5-52; MMS: 14-12-0001-29079.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1975; 1976.

COMPLETION DATE OF REPORT: March 1978.

COST(S): FY 1975: $3,802,641; FY 1976: $127,623; CUMULATIVE PROJECT COST: $3,930,264.

PROJECT MANAGER(S): R. Callahan.

AFFILIATION: Science Applications, Inc.

ADDRESS: P.O. Box 2351, 1200 Prospect Street, La Jolla, California 92037.

PRINCIPAL INVESTIGATOR(S)*: D. Straughan.

KEY WORDS: Southern California; Southern California Bight; baseline; biology; intertidal; mussel; Mytilus; community; photographimetric technique; seasonality; diversity; sandy beach; slough.

BACKGROUND: Multidisciplinary baseline studies conducted on the Southern California Outer Continental Shelf (OCS) under sponsorship of the U.S. Department of the Interior provide essential environmental information related to oil and gas production in this area. The reports contained in this document are focused on the ecology of the intertidal habitat within the Southern California Planning Area.

OBJECTIVES: (1) To provide replicated baseline data for the Southern California intertidal region; (2) To determine proper sampling procedures for sandy beaches and sloughs; and (3) To ecologically characterize the mussel community, sandy beaches, and sloughs.

DESCRIPTION: The study area (about 26,000 km^2) extended from Pt. Conception south to the U.S.-Mexican border from the mean high tide level to approximately 177 km offshore. The two reports contained in this document were ecological studies of: (1) the mussel (Mytilus californianus) community; and (2) beaches and sloughs. The mussel community was sampled at two mainland and four island localities. Ambient water and air temperatures and bed thickness were recorded during each sampling period. Permanent transects were established at each locality. Five cores (300 cm^2) were removed from a 1,500 m^2 area during each quarterly sampling effort. Optimal sample size for each site was determined using cumulative species-area curves. Samples were sorted and organisms identified to the lowest possible taxa. Sediments were analyzed by settling tube and pipetting procedures. Residual or intermussel space was estimated. Twenty small mussels and 10 large mussels were collected during each sampling period for hydrocarbon and trace metal determinations, respectively. Community parameters (diversity, evenness, and richness) were calculated and hierarchical classification (normal and inverse) was employed to examine interstation similarities. Abiotic variables and species composition relationships were examined using multiple discriminant analysis. For the sandy beaches and sloughs study, 17 sites were selected. Base points were selected above the intertidal zone at each site and used to reference profile measurements. Undisturbed sampling, on a quarterly basis, included quantitative photography, bird and mammal records, records of kelp or other debris, tar collection, weather records, and air, water, and substrate temperatures. Disturbed sampling design included single line transects and stratified random quadrats established between high and low tide marks at each site. During sampling visits, three cores (20 cm deep by 7.7 cm diameter) were taken. Sediment samples taken along the profile line were analyzed for grain size, organic content, and moisture content. In marshes, a discontinuous series of quadrats were sampled randomly with a large core (15.4 mm diameter). The sand crab (Emerita analoga) was collected for hydrocarbon and trace metal analyses. Gloves were worn and samples were kept on dry ice at 70° C until laboratory analyses could be performed. Interstation comparisons were achieved using principal components analysis (ordination) and centroid clustering classification. Multiple discriminant analysis was used to relate groups or locations to abiotic variables.

SIGNIFICANT CONCLUSIONS: Mussel communities from [illegible] locations contributed to a master species list of 346 species. Molluscs, primarily mussels, accounted for 90% of the total biomass. The most diverse sampling localities were Coal Oil Point and Santa Cruz Island. No general seasonal species diversity pattern was detected. Mainland communities were distinct from insular communities in species composition. Important structural characteristics of the habitat included sediment and coarse fraction features. Species diversity increased with the quantity of habitat and food resources.

The three mainland sloughs sampled each supported a distinct species assemblage, presumably governed by different salinity regimes at each site. Sandy beach communities did not display any specific island or continental affinities. Sandy beach communities were influenced by site-specific physical factors rather than by seasonal influences. In general, the highest amounts of tar occurred on low energy beaches.

STUDY RESULTS: Mussel community collection sites were generally characterized by stable substrates and areas exposed to direct surge and wave action. Community composition included 346 taxa in 12 phyla: annelids, molluscs, and arthropoda accounted for approximately 70% of the species. Polychaetes were represented by 111 species; however, only 31 occurred at three or more sites. Molluscs accounted for 90% of the total biomass. Coal Oil Point and San Nicolas Island supported the greatest biomass, while Santa Barbara Island supported the lowest. Sample size determination indicated that five samples were optimal for most sites; however, at Nicolas Island, nine samples were considered optimal. Diversity, evenness, and richness were relatively consistent throughout the year. Coal Oil Point and Santa Cruz Island had the highest mean number of species (73 and 74, respectively), and the San Diego mussel bed had the lowest (46).

Characteristic species groups for both mainland and island localities remained relatively constant through the normal classification analyses. Seasonally, mainland localities (Coal Oil Point and San Diego) displayed very similar species groups in both first and third quarter classifications. Overall, mainland sites were distinct from island localities throughout the year. Twenty species, out of 65 examined, exhibited abundance differences which may be correlated with intertidal height differences.

At sandy beach localities, temperatures generally increased in a north-south direction; highest water temperatures (21° C) were recorded in shallow marshes during July. Air temperatures recorded at sandy beach and slough locations varied with weather, geographic location, and sampling time. Substrate temperatures varied with air and water temperatures as well as weather. Salinities at sandy beaches ranged from 32 to 35 ppt. A low salinity of 25 ppt, due to seepage from a nearby creek, was recorded at Corona Del Mar. Each slough had different salinities, ranging from 20 to 40 ppt. Salinities were dependent on ocean exposure, season, and rainfall. Largest amounts of surface tar noted as gm total weight of tar per quadrant were recorded at Coal Oil Point (11,927.4 g) and Twin Harbors (3,743.9 g). No tar was recorded from Point Mugu, Outer Cabrillo, Corona Del Mar, San Miguel Island, and San Clemente Island. Tidal height range was influenced by wind, beach profile, and seasonal tidal fluctuations. Sediment grain size varied among locations, and seasonal cycles of erosion and deposition were evident. The average moisture content of sandy beaches was associated with sediment grain size: coarse sediments held less water. In mainland sandy beaches, organic content ranged from 0.14 to 0.30%; on island sandy beaches, organic content reached 0.61%. Presence of mammals, kelp, or tar correlated with the observed organic content at most sites. A total of 240 taxa were recorded from sandy beaches and sloughs, and eight plant species were identified growing in the marshes. Twin Harbors Beach, on Santa Catalina Island, yielded the greatest number of species (96). Mainland marshes yielded 144 species. The common sand crab (Emerita analoga) was the most ubiquitous species. Major taxa collected were: Annelida, Nemertea, Phoronida, Insecta, Arachnida, Crustacea, Mollusca, Echinodermata, and Pisces. Classification revealed that insular and mainland beaches were similar with respect to species occurrence. Differences between the biota at different sites were greater than overall seasonal differences between surveys. Important abiotic variables identified by multiple discriminant analysis of sandy beaches were beach length and tar presence, and to a lesser extent moisture content and salinity. For marshes, intertidal range and salinity were significant abiotic factors in the ordinations. Box samples (0.3 m^3) were ideal for determining close relationships between species and abiotic factors, but were inadequate for assessing species composition at specific sites. Only some species could be accurately correlated with particular environmental variables.

STUDY PRODUCT(S): Straughan, D. and R. Kanter. 1978. Mussel Community Study. In: Southern California Baseline Study Intertidal and Benthic 1975-1976 (Year I), Vol. III, Report 2.2. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB80-218035/AS. Contract No. 08550-CT5-52. 132 pp. + app.

Straughan, D. 1978. Sandy Beaches and Sloughs. In: Southern California Baseline Study Intertidal and Benthic 1975-1976 (Year I), Vol. III, Report 2.3. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB80-218035. Contract No. PB80-218035/AS. 119 pp. + app.

*P.I.'s affiliation may be different than that listed for Project Manager(s).

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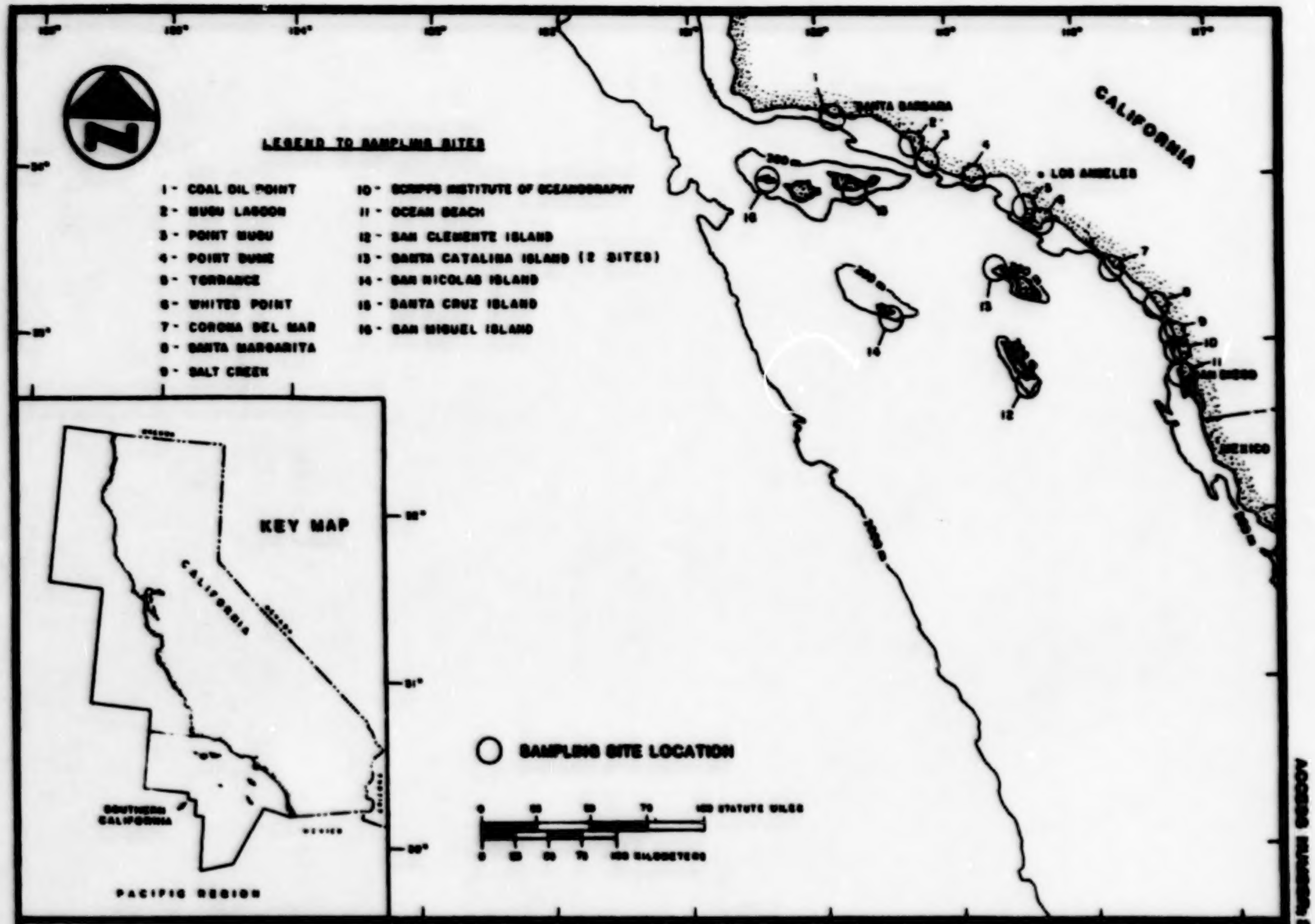

SAMPLING SITE LOCATIONS FOR THE SOUTHERN CALIFORNIA BASELINE STUDY, YEAR I.

ACCESS NUMBER: 29079.4

ACCESS NUMBER: 29079.4

ACCESS NUMBER: **29079.5**

STUDY TITLE: Southern California Bight Baseline, Year I.

REPORT TITLE: Southern California Baseline Study Intertidal and Benthic 1975-76 (Year I), Vol. III, Report 2.4 - Benthic Macrofauna; Report 2.5 - Benthic Microfauna.

CONTRACT NUMBER(S): BLM: CT5-52; MMS: 14-12-0001-29079.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1975; 1976.

COMPLETION DATE OF REPORT: March 1978.

COST(S): FY 1975: $3,802,641; FY 1976: $127,623; CUMULATIVE PROJECT COST: $3,930,264.

PROJECT MANAGER(S): R. Callahan.

AFFILIATION: Science Applications, Inc.

ADDRESS: P.O. Box 2351, 1200 Prospect Street, La Jolla, California 92037.

PRINCIPAL INVESTIGATOR(S)*: R. Douglas, K. Fauchald, G. Jones.

KEY WORDS: Southern California; Southern California Bight; Tanner-Cortes Banks; baseline; biology; benthos; infauna; foraminifera; sediment; faunal zones; distribution; grain size.

BACKGROUND: Prior to leasing of the Southern California OCS, an extensive program of environmental studies was conducted by the U.S. Department of the Interior. The benthic faunal studies conducted as part of this program were among the largest ever undertaken in this area. Unlike previous studies in the area, the present benthic investigations studied the biota of every major habitat of the Southern California Bight. Of most importance, the study intensively surveyed the fauna of the slope--heretofore poorly sampled--and outer island shelves, banks, and ridges--almost unknown to science and sampled extensively for the first time.

OBJECTIVES: (1) To determine the abundance, composition, diversity, and general health of the benthic macrofauna of the Southern California Bight prior to oil and gas development in the area; (2) To document the occurrence, distribution, standing crop, and diversity of Foraminifera; (3) To describe Foraminifera communities and define their boundaries; (4) To correlate Foraminifera distribution with the physical environment; and (5) To assess the value of Foraminifera as indicators of man-induced alterations in the environment.

DESCRIPTION: Benthic macrofauna were collected at 546 stations in 11 high density sampling areas (372 NM^2). The sampling areas were divided into 1-NM^2 areas. An additional 231 stations were located outside the high density sampling areas (HDSAs). Station depths ranged from 7 to 1,886 m. A total of 711 box core samples [using a 0.06 m^2 USNEL box corer (20 x 30 cm)] and 145 trawl and/or dredge samples (using a 1.8-m beam trawl or rock dredge) were collected. Specimens were identified to the lowest practical taxonomic classification and described using the following methods of sample analysis. Data were analyzed using classification techniques; rankings of numerically dominant taxa; diversity, evenness, dominance indices; and plotting subroutines.

A total of 268 Foraminifera samples were collected using a box corer or Van Veen grab sampler. Samples were taken from the top centimeter of the core and 12 to 15 cm below the top of the core. Samples were preserved on board ship after staining with Rose Bengal and later sieved in the laboratory through a 230 mesh (62.5 um) screen. Estimates of standing crop and species diversity were made by counting live (i.e., those Foraminifera which were stained by the Rose Bengal) and dead organisms.

SIGNIFICANT CONCLUSIONS: Benthic macrofauna and Foraminifera community assemblages in the Southern California Bight have been described. The macrofaunal were grouped into four assemblages that were influenced by geographic location as well as physical factors such as depth and sediment characteristics. Five Foraminifera communities were also identified. Distribution of these communities was also largely influenced by depth-related gradients in sediment and water quality.

STUDY RESULTS: The benthic data presented in the report allowed for a description of the faunal species present in the study area, but not spatial and temporal descriptions of the faunal communities.

The 11 HDSAs were grouped into the mainland shelf HDSAs, island shelf HDSAs, open water HDSAs, and an anomalous area (Tanner-Cortes Banks). Mainland shelf HDSA benthic assemblages conformed to bathymetry. Three faunal zones (shallow water, intermediate, and deep water) were recognized. The numbers of species and specimens were inversely proportional to depth. In general, standing crops were lower in deep water than at shallow and intermediate depths. Faunal patterns were less distinct in the island shelf HDSAs. Faunal distributions correlated with bathymetry at the San Miguel Island HDSA and substrate type at the Santa Rosa Island HDSA (which had a limited depth range). Species richness, abundance, and standing crops were high throughout the areas. At the San Miguel Island HDSA, standing crops were highest in deeper offshore areas. The open water HDSAs showed varying results. No distinct faunal associations were observed in the Santa Catalina Island HDSA except along the northern margin of the area where standing crops were low. The Santa Cruz Basin HDSA fauna could be grouped into shallow water, slope, and basin associations. The fauna of the Santa Rosa Ridge HDSA were similar to the shallow water fauna of the Santa Cruz Basin HDSA. The Tanner Bank HDSA fauna were similar to the slope fauna of the Santa Cruz Basin HDSA. Discontinuous faunal distribution patterns and complex substrate types characterized the Tanner-Cortes Banks HDSA. However, clear distinctions existed between the fauna of the bank tops and that of the troughs between the banks. In spite of the species differences, species richness, population density, and standing crops were similar.

Echinoderms were distributed in four depth zones: <100 m, 100 to 250 m, 300 to 1,000 m, and >1,000 m. In water less than 100 m deep, the brittle star Amphiodia urtica dominated on fine sediments and Amphipholis sp. was dominant or codominant where shell debris was present. Sea urchins were dominant from 100 to 300 m depth. The brittle stars Ophiomusium jolliensis and Asteronyx longifissus and the starfish Myxoderma platyacanthum were dominant at depths between 500 and 1,000 m. Basin floors greater than 1,000 m deep had a fauna dominated by the brittle stars Ophiura leptoctenia, Ophiophthalmus normani, and Ophiacantha sp. and the holothuroid Scotoplanes sp. Only two crustacean zones were recognized in shallow (<300 m) and deep waters. The shallow water fauna formed two groups associated with soft silts and clays or gravel and boulders. At greater than 300 m depth, crustacean numbers were uniform but species numbers were low.

For molluscs, three distinct patterns were identified for soft bottoms. These included a sand associated fauna in very shallow water, a silt and clay assemblage at depths of less than 50 m, and a fauna dominated by Cyclocardia ventricosa in 50 to 100 m depth. Polychaete zones were established in shallow water (one associated with sand and another with silt and clay) on the slope between 200 and 500 m, and in the basins at depths exceeding 1,000 m.

Five Foraminifera communities were identified in the study area using cluster analysis. Four of these communities are predominantly found in shallow waters (<15 m) of the mainland and insular shelf and the offshore banks and ridges. A fifth community is found in deepwater environments below the shelf edge. Characterizations of faunal patterns using standing crop, live/dead ratios, and species diversity proved to be less useful than expected. Of these factors, however, standing crop appeared to be the most useful in faunal/environmental relationships. Species diversity patterns indicated higher than average number of species around sewage outfalls and similar numbers of species in areas with and without oil seeps. The standing crop, diversity, and composition of the fauna appear to be strongly influenced by temporal changes.

Faunal distributions are correlated with depth-related gradients in sediment and water quality (particularly salinity and oxygen). These dependencies make the Foraminifera sensitive indicators of water and sediment quality. The Foraminifera communities were discriminated in terms of six variables that define water and sediment quality: temperature, salinity, oxygen, mean grain size, percent carbonate, and percent organic carbon of the sediments.

STUDY PRODUCT(S): Fauchald, K. and G. Jones. 1978. Benthic Macrofauna. In: Southern California Baseline Study Intertidal and Benthic 1975-1976 (Year I), Vol. III, Report 2.4. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB83-149799. Contract No. 08550 CT5-52. 416 pp. + Addendum (Taxonomic Findings).

Douglas, R. G., C. Walch, and G. Blake. 1978. Benthic Macrofauna. In: Southern California Baseline Study Intertidal and Benthic 1975-1976 (Year I), Vol. III, Report 2.5. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB83-149799. Contract No. 08550-CT5-52. 358 pp.

*P.I.'s affiliation may be different than that listed for Project Manager(s).

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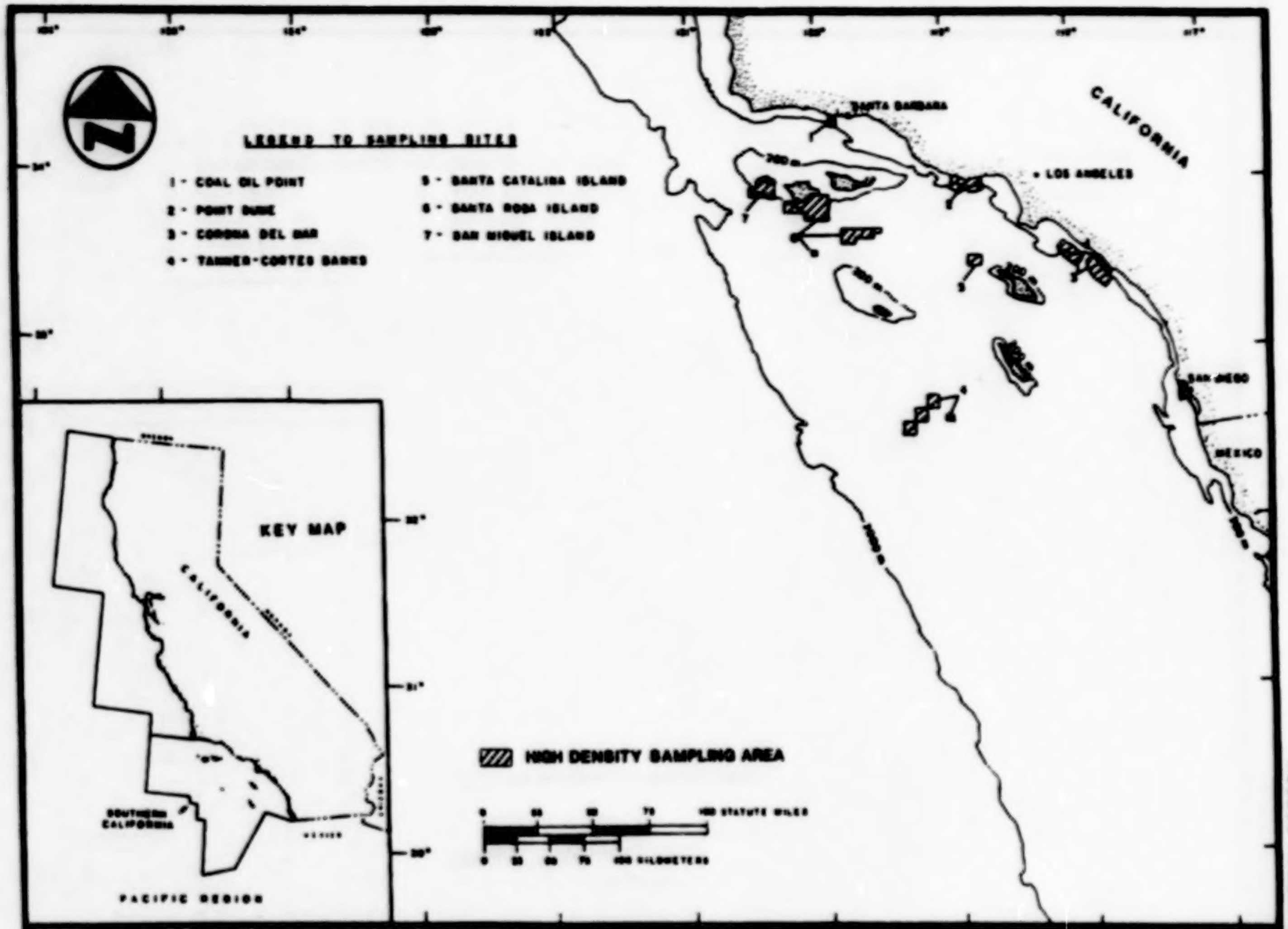

HIGH DENSITY SAMPLING AREAS FOR SOUTHERN CALIFORNIA BASELINE STUDY, YEAR I.

ACCESS NUMBER: **29079.6**

STUDY TITLE: Southern California Bight Baseline, Year I.

REPORT TITLE: Southern California Baseline Study Intertidal and Benthic 1975-76 (Year I), Vol. III, Report 2.6 - A Kelp Survey of the Southern California Bight.

CONTRACT NUMBER(S): BLM: CT5-52; MMS: 14-12-0001-29079.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1975; 1976.

COMPLETION DATE OF REPORT: March 1978.

COST(S): FY 1975: $3,802,641; FY 1976: $127,623; CUMULATIVE PROJECT COST: $3,930,264.

PROJECT MANAGER(S): R. Callahan.

AFFILIATION: Science Applications, Inc.

ADDRESS: P.O. Box 2351, 1200 Prospect Street, La Jolla, California 92037.

PRINCIPAL INVESTIGATOR(S)*: D. Hodder.

KEY WORDS: Southern California; Southern California Bight; baseline; biology; aerial photography; historical review; kelp; Macrocystis; Channel Islands; maps; literature review.

BACKGROUND: The Southern California Baseline Study was a large multi-year, multidisciplinary marine program that was conducted to provide the U.S. Department of the Interior with information necessary to assess the potential environmental impacts of leasing tracts of submarine lands for commercial oil production and to properly manage marine resources if recovery of petroleum occurs. Studies within the program were designed to provide an overview of the Outer Continental Shelf (OCS) chemical, biological, and sedimentological regimes and statistical baseline of the sandy beach and rocky intertidal communities. The study section herein abstracted is only a part of the Year I study.

OBJECTIVES: (1) To develop a methodology for aerial survey and analysis of kelp beds; (2) To survey the distribution of kelp in the Southern California Bight; and (3) To seek causal information on the spatial distribution of kelp.

DESCRIPTION: Four quarterly surveys, photointerpretation, mapping, and computer processing of all known and historic kelp beds from Point Conception to the Mexican border, including the Channel Islands was accomplished during the period of September 1975 through April 1976. Aerial photography was obtained with a motorized Hassleblad 70-mm camera equipped with a 300-ft film magazine and a 50-mm Zeiss lens. Color infrared film (type 2443) was used with a yellow (Wratten #12) filter. A 60% frame-to-frame overlap permits stereo viewing of the photographs. Imagery was obtained from an altitude of 1,829 m over Santa Cruz, Anacapa, San Clemente, Santa Rose, and San Miguel Islands and at an altitude of 2,438 m Santa Barbara, San Nicolas, and the mainland coast.

Because of the uncertainty of identifying subsurface kelp from photographs, only kelp which had fronds exposed on the surface were mapped. The map numbering scheme was derived from the State of California's "Official Kelp Bed" map. Each manuscript map was an overlay to a standard U.S. Geological Survey 7-1/2-min quadrangle chart. Baseline data from each of the overlays were fed into a omputer through digitization of kelp patch boundaries on an X-Y coordinate base. Area of individual kelp patches was computed as well as an evaluation of seasonal changes.

SIGNIFICANT CONCLUSIONS: A complete methodology for aerial analysis was developed. Distribution of kelp beds was determined for the Southern California Bight and Channel Islands. A comparison of Bureau of Soils survey of 1911 clearly showed that island kelp beds have maintained coverage better than mainland beds.

STUDY RESULTS: Photographic imagery was interpreted to determine the location and extent of significant surface canopy formed by the kelp Macrocystis and associated marine algae. Data from each quarterly survey were digitized and computer-inventoried. Final maps for each survey were computer plotted to show changes occurring in sequential surveys. Statistical tabulations were computer-generated to show the area of each individual kelp patch and totals for each map overlay. In addition, the computer listings show the area of each patch with the State of California kelp bed numbering system and totals for each of these. Methodology was extended to provide computer calculation and a listing of changes between one survey and the next.

An extensive literature review was conducted to analyze all known factors which affect the distribution of kelp plants. These factors were analyzed to determine which factors could realistically be ascribed to changes noted in sequential aerial photographs. Certain kinds of processes, such as removal of canopy by storm damage and the location of kelp harvesting can be interpreted from photographs, but other data, such as the effects of sea urchins and grazing fishes, require on-site inspection.

The unusually mild winter experienced during 1975-1976 caused only small losses in the surface kelp canopy along the mainland coast. Largest acreage was recorded during August 1975, and this steadily declined to about 97% of the mean total by April 1976. Much of the fluctuation was due to artificial and temporary removal of the kelp canopy by kelp-harvesting barges.

Kelp beds along the west, northeast, and southwest facing coasts of the Channel Islands have sustained damage from high wind waves and surface currents during the winter and spring months. No direct relationship can be established between trends on the Channel Islands and the mainland coast.

Comparing the surface canopy of all kelp beds to the acreage estimated by the Bureau of Soils survey of 1911, it is clear that island beds have generally maintained their coverage better than mainland beds in recent decades. A gradual decline in most mainland beds caused a low point in their composite area in about 1960 following the warm water years of 1957 to 1959. This trend was not quite as strong at the Channel Islands, and present acreage is about one third of the 1911 estimate at the island beds.

ACCESS NUMBER: **29079.6**

STUDY PRODUCT(S): Hodder, D. T. and M. R. Mel. 1978. A Kelp Survey of the Southern California Bight. In: Southern California Baseline Study Intertidal and Benthic 1975-1976 (Year II), Vol. III, Report 2.6. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB83-174821. Contract No. 08550-CT5-52. 80 pp. + app.

*P.I.'s affiliation may be different than that listed for Project Manager(s).

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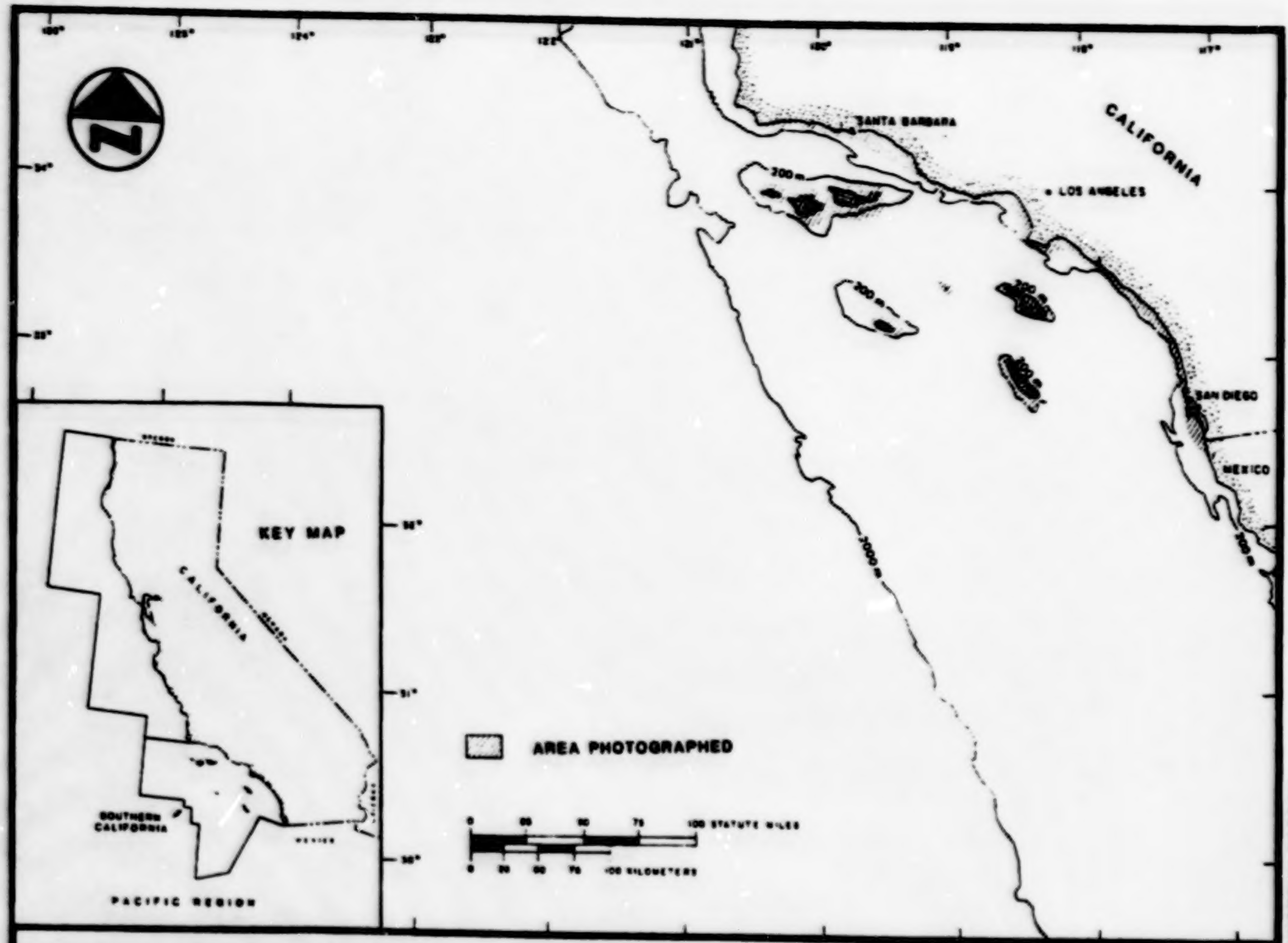

KELP SURVEY AREAS OVERFLOWN DURING THE SOUTHERN CALIFORNIA BASELINE STUDY, YEAR I.

ACCESS NUMBER:29079.6

ACCESS NUMBER: 29079.6

ACCESS NUMBER: **29079.7**

STUDY TITLE: Southern California Bight Baseline, Year I.

REPORT TITLE: Southern California Baseline Study Intertidal and Benthic 1975-1976 (Year I), Vol. III, Reports 3.1 - High Molecular Weight Hydrocarbons Analysis in Sediments; Report 3.2.1 - Physical Oceanography; Report 3.2.2 - Particulate and Dissolved Organic Carbon Analysis; Report 3.2.3 - Hydrocarbons in the Water Column; Report 3.2.4 - Needs for Methodologies for the Determination of Petroleum Compounds in Seawater; Report 3.3 - Hydrocarbons in Benthic Fauna; Report 3.4 - Intertidal Fauna and Flora; Report 3.5 - Faunal and Water Column GC/MS; Report 3.6 - High Molecular Weight Hydrocarbons Gas-Liquid Chromatography Analysis.

CONTRACT NUMBER(S): BLM: CT5-52; MMS: 14-12-0001-29079.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1975; 1976.

COMPLETION DATE OF REPORT: March 1978.

COST(S): FY 1975: $3,802,641; FY 1976: $127,623; CUMULATIVE PROJECT COST: $3,930,264.

PROJECT MANAGER(S): R. Callahan.

AFFILIATION: Science Applications, Inc.

ADDRESS: P.O. Box 2351, 1200 Prospect Street, La Jolla, California 92037.

PRINCIPAL INVESTIGATOR(S)*: A. Benson, A. Burlingame, O. Holm-Hansen, I. Kaplan, M. Moberg, R. Risebrough.

KEY WORDS: Southern California; Southern California Bight; baseline; biology; hydrocarbons; sediment; benthos; intertidal; infauna; epifauna; macrophytes; grain size; Channel Islands; tissue; gas chromatography; spectrometry.

BACKGROUND: This report summarizes the results of the first year of a study designed to provide descriptive data for a 26,000 km^2 area of the Southern California Bight extending from Pt. Conception to the U.S-Mexican border. Chemistry data were collected to provide baseline hydrocarbon patterns in the water column, sediments, and biota prior to Outer Continental Shelf (OCS) leasing for oil and gas development.

OBJECTIVES: (1) To determine the distribution of petroleum in sediments and to characterize the type of hydrocarbons present; (2) To determine whether the hydrocarbon composition of seawater and surface sediments reflect the composition of nearby oil seeps; (3) To measure the particulate organic carbon (POC) and dissolved organic carbon (DOC) in the water column at selected sites; (4) To characterize hydrocarbons in the water column; (5) To develop techniques for in situ sampling systems; and (6) To characterize the distribution of petroleum hydrocarbons in benthic and intertidal flora and fauna.

DESCRIPTION: The sampling program consisted of 527 stations in 10 areas designated high density sampling areas (HDSAs). An additional 250 stations were scattered between the

HDSAs. At 145 of the 777 stations, sediment samples were collected over an eight-month period for petroleum hydrocarbons. At 41 of 145 stations, water samples were collected for hydrocarbon analyses. After extraction, all water, sediment, and biotal samples were analyzed using gas chromatograph (GC) or gas chromatograph/mass spectrometry (GC/MS) techniques. Much of the first year emphasis focused on development of new techniques for the collection and analysis of samples for hydrocarbon contamination. Many techniques involved sampling devices, filtering systems, and clean room procedures that were new to science. Procedures were designed to minimize outside contamination of the samples.

SIGNIFICANT CONCLUSIONS: The Southern California Bight is contaminated with hydrocarbons that originate from several sources including natural seeps, industrial and municipal outfalls, commercial fishing, recreational boating, and petroleum operations. Contamination is reflected in the water column, sediments, and biota, particularly in Santa Monica and San Pedro basins and bays. Coal Oil Point is contaminated by natural seeps.

STUDY RESULTS: Surface water POC concentrations ranged from 50 ug C l^{-1} for offshore waters and 130 to 258 ug C l^{-1} for coastal waters. Highest values were obtained from Coal Oil Point. DOC concentrations ranged from 0.7 to 1.4 ug C l^{-1}. No direct correlation existed between POC and DOC values. DOC concentrations did not show consistent differences between coastal and offshore stations. While POC determinations may be useful measurements for monitoring, DOC measurements appear to be of limited use.

Water column hydrocarbons were an order of magnitude lower than values previously reported because of the development of new sampling and sample processing techniques to minimize hydrocarbon contamination. However, concentrations between stations were variable and differences existed in the characteristic profiles of the hydrocarbons at these stations. Based on the analytical results, it was possible to distinguish clean sites from areas of natural seeps and heavy industrial input.

Coastal stations could be discerned from other stations by the presence of steranes and hemicosahexane. Chlorinated hydrocarbons were identified by GC/MS in faunal and sediment samples but not water samples. Phthalates and adipates (used in the manufacture of polyvinyl chloride products) were identified in samples of all kinds. Their discovery in conjunction with the presence of the chlorinated hydrocarbons in some samples suggests a large contribution of synthetic chemicals into the Southern California marine system. The compounds indicated petroleum and anthropogenic pollution were distributed throughout the study area.

Sediments at outer banks, ridges, and areas south of Newport Beach had total hydrocarbon concentrations less than 50 ug g^{-1}, whereas stations in basins had concentrations from 50 to 100 ug g^{-1}. In Santa Monica and San Pedro basins and bays, concentrations ranged from 200 to 1,354 ug g^{-1}. Coal Oil Point had concentrations measured at approximately 600 ug g^{-1}. The differences between nearshore and offshore areas were not related to grain size and may indicate that the hydrocarbons originate from anthropogenic and natural seep sources.

Concentrations of total hydrocarbons at two intertidal sites were 6 to 15 ug g^{-1} and 8 to 30 ug g^{-1}. The latter concentrations were measured at Coal Oil Point. Based on GC/MS analyses, it was suggested that the northern Channel Islands area was relatively free of anthropogenic contamination. The central Channel Islands area was contaminated by petroleum hydrocarbons from sewage and industrial effluents. However, only one of three samples from the south coastal area (near major metropolitan centers) gave indications of contamination from anthropogenic sources. Samples from the outer basins and banks gave the most striking results with indications of both anthropogenic and petroleum constituents. This may indicate the presence of an industrial dumpsite and/or an oil seep. Anthropogenic contamination was also evident at the Tanner-Cortes banks.

A total of 294 benthic species were analyzed by GC techniques. Hydrocarbon burden was greatest in samples from the mainland shelf from Coal Oil Point to Huntington Beach. Factors contributing to the contamination may include natural seeps, municipal/industrial outfalls, and industrial/refining operations. Samples from the shelf and slope south of Huntington Beach were relatively clean. The outer areas were relatively clean except for the Santa Rosa Island HDSA where a seep may be present. Chlorinated hydrocarbons were detected in most areas with the most prominent samples collected in Santa Monica and San Pedro bays and basins.

A total of 210 intertidal organisms representing 28 species were collected from 16 sites for hydrocarbon analyses. Based on tissue measurements of mussels (Mytilus californianus), Coal Oil Point was heavily contaminated by petroleum hydrocarbons. Corona del Mar, Palos Verdes, San Clemente Island, and San Diego appeared to be lightly or moderately contaminated at some time during the year. Samples from San Nicholas, Santa Cruz, San Miguel, and Santa Barbara Island remained relatively uncontaminated throughout the collection season.

GC traces of water and sediment samples collected near a seep showed similar characteristics. However, the sediments in the area are highly enriched in hydrocarbons as compared to the water column. Hydrocarbons in the water column are 2.5 to 18 times more concentrated in the seep area than background; concentrations in the sediments are 22 to 1,000 times above background levels.

STUDY PRODUCT(S): Science Applications, Inc. 1978. Southern California Baseline Study Intertidal and Benthic, 1975-76 (Year I). Vol. III, Report 3.1 - High Molecular Weight Hydrocarbon Analysis on Sediments; Report 3.2 - Physical Oceanography and Water Column Analyses. A final report for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB83-174839. Contract No. 08550-CT5-52.

Science Applications, Inc. 1978. Southern California Baseline Study Intertidal and Benthic, 1975-76 (Year I). Vol III, Report 3.3 - Hydrocarbons in Benthic Fauna; Report 3.4 - Intertidal Fauna and Flora; Report 3.5 - Faunal and Water Column GC/MS; Report 3.6 - High Molecular-Weight-Hydrocarbon Gas-Liquid Chromatography Analysis. A final report for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB83-174847. Contract No. 08550-CT5-52.

The previous citations represent a compendium of reports, each authored separately and covering a unique topic or area. Specific report authors include those cited under P.I.

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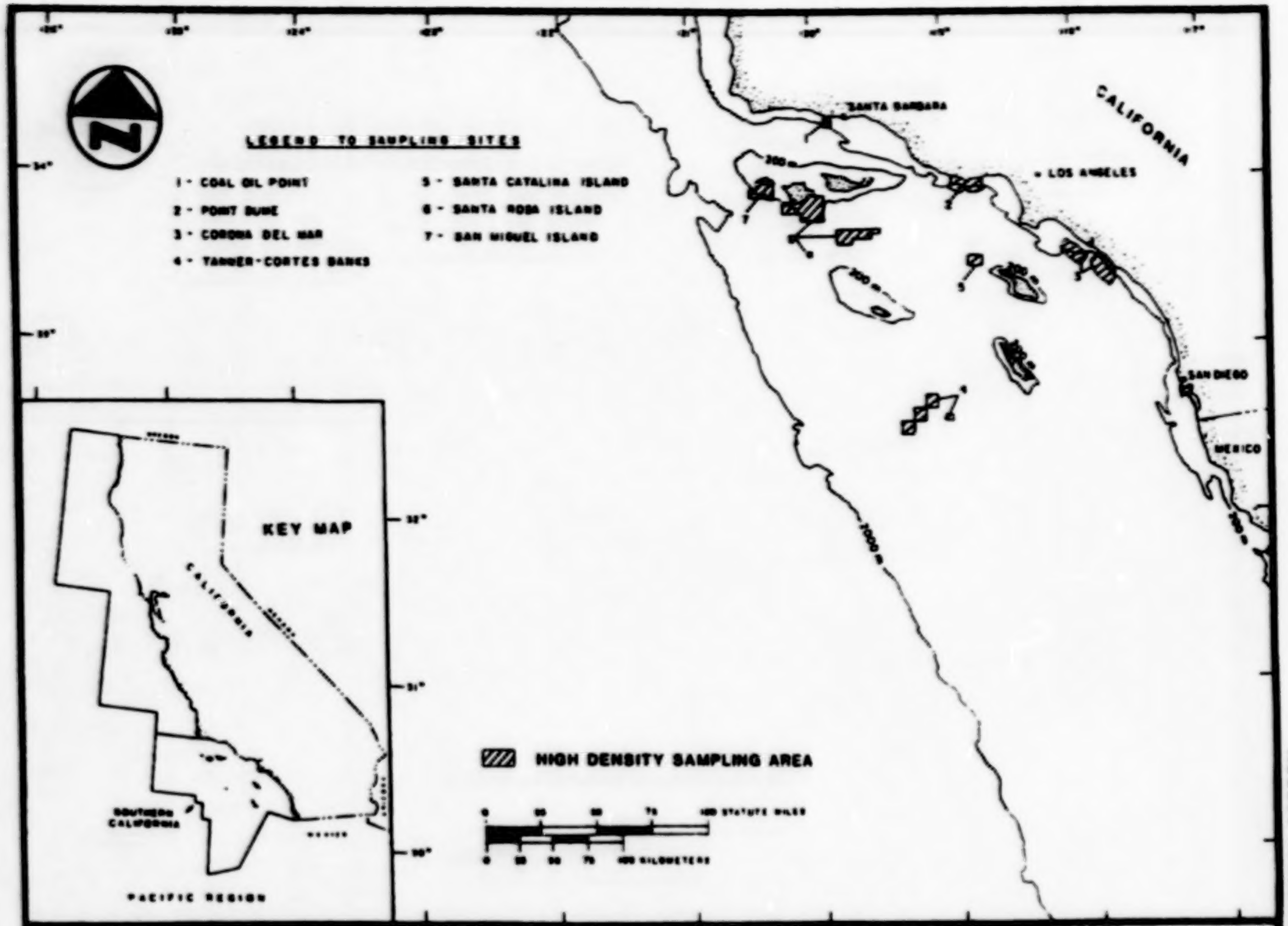

SAMPLING SITE LOCATIONS FOR THE SOUTHERN CALIFORNIA BASELINE STUDY, YEAR I.

ACCESS NUMBER:29079.7

ACCESS NUMBER: 29079.7

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ACCESS NUMBER: **29079.8**

STUDY TITLE: Southern California Bight Baseline, Year I.

REPORT TITLE: Southern California Baseline Study Intertidal and Benthic 1975-76 (Year I), Vol. III, Report 4.1.1 - Trace Metals in Sediments; Report 4.1.2 - Barium and Vanadium in Sediments Determined by NAA; Report 4.2.1 - Summary of Physical Oceanography; Report 4.2.2 - Trace Metals in the Water Column; Report 4.2.3 - Barium and Vanadium in the Water Column; Report 4.2.4 - Barium in the Water Column; Report 4.3.1 - Trace Metals in Fauna and Flora; Report 4.3.2 - Barium and Vanadium in Flora and Fauna.

CONTRACT NUMBER(S): BLM: CT5-52; MMS: 14-12-0001-29079.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1975; 1976.

COMPLETION DATE OF REPORT: March 1978.

COST(S): FY 1975: $3,802,641; FY 1976: $127,623; CUMULATIVE PROJECT COST: $3,930,264.

PROJECT MANAGER(S): R. Callahan.

AFFILIATION: Science Applications, Inc.

ADDRESS: P.O. Box 2351, 1200 Prospect Street, La Jolla, California 92037.

PRINCIPAL INVESTIGATOR(S)*: A. Bainbridge, K. Bruland, T. Chow, J. Martin, V. Orphan, C. Patterson.

KEY WORDS: Southern California; Southern California Bight; baseline; biology; trace metals; sediment; water column; hydrography; spectroscopy; epifauna; intertidal; seasonality.

BACKGROUND: The Southern California Baseline Study was a large multi-year, multidisciplinary marine program conducted to provide information necessary to assess the potential impacts of leasing for commercial oil production and to properly manage marine resources. Studies were designed to provide an overview of chemical, biological, and sedimentological regimes and a statistical baseline of the sand beach and rocky intertidal floral and faunal communities. The Year I study investigates mainly the trace metals in sediments, water column, and flora and fauna.

OBJECTIVES: (1) To determine baseline or trend concentrations of selected trace metals in sediment, water, and biotal samples; (2) To collect and determine collateral data (temperature, salinity, dissolved oxygen, light transmission) to support analysis of hydrocarbons, trace metals, and particulate organic carbon; (3) To investigate the use of more sensitive but less standard methods of analysis; and (4) To provide insight into which organisms would be useful indicators of trace metal pollution.

DESCRIPTION: Water samples were collected at 41 stations. Near-surface water collection was accomplished by sampling 10 m up current of the ship with an all-teflon diaphragm pump attached to polyethylene tubing. Deeper water samples were collected with a teflon-coated 30-l top-drop Niskin sampler. Samples were pressure filtered and the particulates were analyzed by atomic absorption spectroscopy (AAS) and instrumental neutron activation analysis (INAA).

Sediment samples were collected by: (1) subsampling the upper 1 cm from a benthic box corer or grab from 145 stations; and (2) coring at varying depths for 62 intertidal sediment samples. Sediment samples were ashed, subjected mainly to total dissolution, and analyzed by flame and flameless AAS and INAA.

Biological samples were sampled or subsampled using nontalced gloves and polypropylene or teflon tools. Samples were rinsed with area seawater and stored in precleaned plastic bags. Tissue samples were subjected to total dissolution and analyzed by flame and flameless AAS and INAA.

In general, cadmium (Cd), chromium (Cr), copper (Cu), nickel (Ni), lead (Pb), vanadium (V), zinc (Zn), and a barium (Ba) determinations were made with flame and flameless AAS. Most Ba and V samples were determined by INAA. A few Ba and Pb samples were determined by mass spectroscopy/isotope dilution.

SIGNIFICANT CONCLUSIONS: Nearshore trace metal concentrations fluctuated with location, exhibiting enrichments near urban and industrial activity. Urban outfall areas were contaminated with Pb, Cd, Cr, and Zn. Nearshore basins appeared to be the final residence for urban-produced concentrations of trace metals. Biota from trace metal contaminated locations typically incorporated the metals into their tissues.

STUDY RESULTS: Trace heavy metal distributions in sediments and suspended particulates off Southern California were highly variable. Elevations of metal concentrations from one area relative to another are not necessarily related to pollution sources or man-induced effects. Interpretation of metal data has to consider all aspects of the geochemical environments from which samples are collected when evaluations are made as to the effects of unnatural chemical impacts. For example, fine-grained, clay-rich, basin sediments tend to have the highest trace metal content. Exceptions include relatively shallow sediments collected near sewage outfalls off the Los Angeles metropolitan area, some having very high concentrations of some metals (especially Cd, Cr, Cu, Pb, and Zn). Another exception would be sediments from some shallow shelves and banks. These settings often had very high Cr (and sometimes V) content resulting from the presence of minerals such as chromite.

In general, metal concentrations of water column particulates and bottom sediments reflect the chemistries of source materials. Particulate material suspended in outer area waters is somewhat different from that found nearshore; the material is a combination of relatively coarse debris from islands and outer banks (Tanner and Cortes) and other bodies of living and dead planktonic organisms. In most cases, there are slight elevations in metal concentrations of deep particulates relative to surface particulates. Only Ba, which decreases in concentration with water depth, and Cd, which is relatively uniform with depth, depart from this trend. Generally, metal concentrations of suspended particulates from near-bottom waters are elevated relative to deposited sediments lying beneath.

Three brittle star, two sea urchin, and one sea star species showed Cr, Cu, Ni, and Pb enrichment when collected from outfall areas. One brittle star species had elevated Pb levels at Huntington Beach (near a sewage outfall) relative to Coal Oil Point (an area of natural oil seepage). High Cr levels were associated with proximity to coastal outfalls, and appeared to be especially enriched in one species of sea urchin. In addition, a few metals were found in high concentrations in tissues from the outer basins and from the banks area. This was especially true for Cd.

Seasonal differences in metal levels for any intertidal species could not be statistically defined. Sampling and analysis of only a few individuals of a species resulted in chemical data of high variability. These data are of limited use in the establishment of well-defined "baseline" conditions; however, they do provide initial indications of the chemical concentrations and variations to be anticipated in subsequent monitoring surveys.

Trace heavy metal distributions in beach sands and sand crab tissues failed to suggest coherent patterns corresponding to community variability.

STUDY PRODUCT(S): Science Applications, Inc. 1978. Southern California Baseline Study Intertidal and Benthic 1975-16 (Year I). Vol. III, Report 4.1 - Sediments; Report 4.2 - Water Column; Report 4.3 - Flora and Fauna. A final report for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB83-149799. Contract No. 08550-CT5-52.

The previous citation represents a compendium of reports, each authored separately and covering a unique topic or area. Specific report numbers and titles, accompanied parenthetically by the respective author(s), are as follows:

Trace Metals in Sediments. Report 4.1.1 (Chow, T. J. and J. Earl).

Barium and Vanadium in Sediments Determined by NAA. Report 4.1.2 (Orphan, V. J., N. Hansen, J. H. Reed, and V. Guinn).

Summary of Physical Oceanography. Report 4.2.1 (Bainbridge, A. E.).

Trace Metals in the Water Column. Report 4.2.2 (Bruland, K. W. and R. P. Franks).

Barium and Vanadium in the Water Column. Report 4.2.3 (Orphan, V. J., J. H. Reed, N. Hansen, and V. Guinn).

Barium in the Water Column. Report 4.2.4 (Chow, J. J.).

Trace Metals in Fauna and Flora. Report 4.3.1 (Martin, J. H., M. Gordon, and G. Krauer).

Barium and Vanadium in Flora and Fauna. Report 4.3.2 (Orphan, V. J., V. Guinn, J. H. Reed, and N. Hansen).

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*P.I.'s affiliation may be different than that listed for Project Manager(s).

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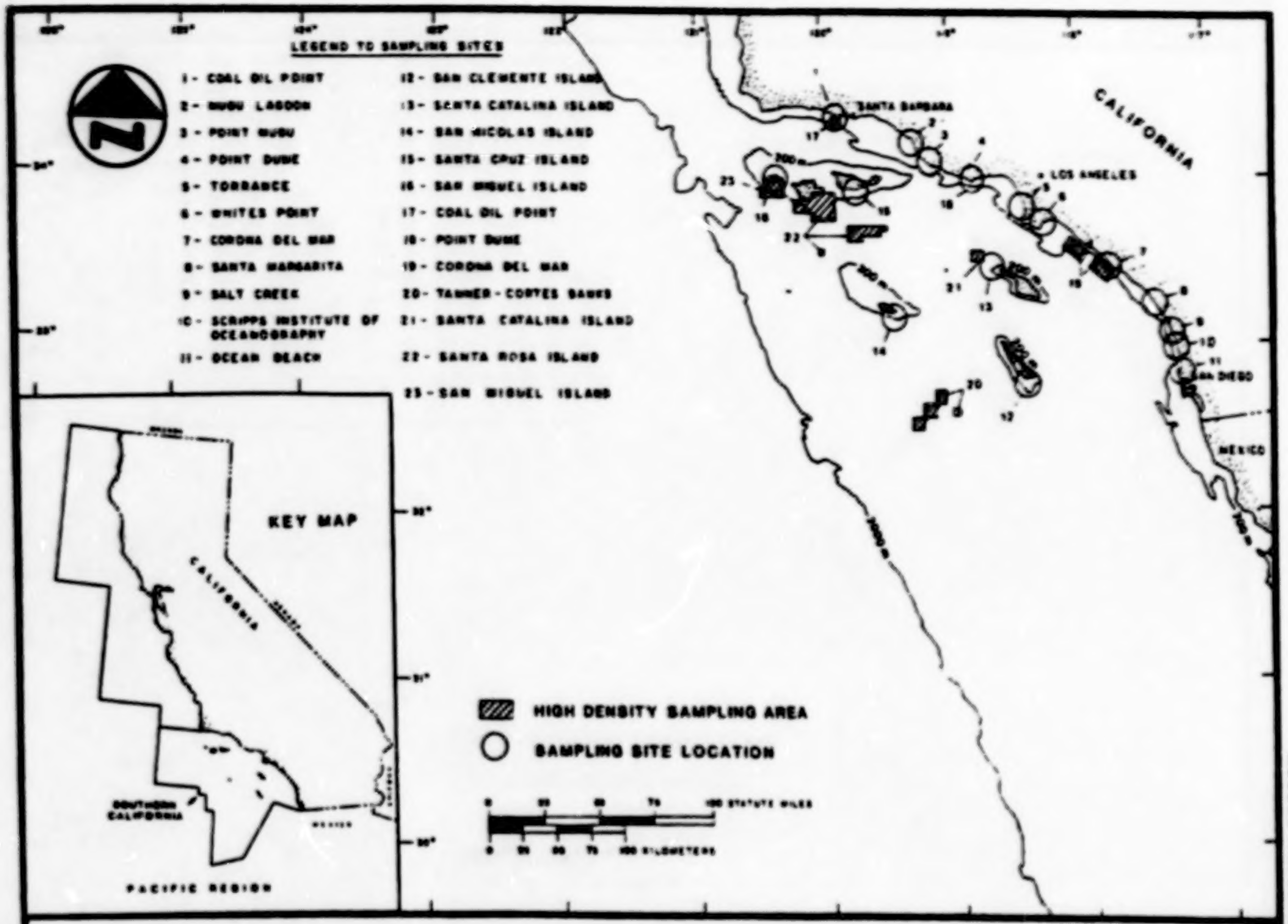

SAMPLING SITE LOCATIONS FOR THE SOUTHERN CALIFORNIA BASELINE STUDY, YEAR I.

ACCESS NUMBER: 29079.8

ACCESS NUMBER: **29080**

STUDY TITLE: Southern California Bight Intertidal Baseline Study Survey, Year II.

REPORT TITLE: Southern California Intertidal Baseline Study: Summary and Synthesis.

CONTRACT NUMBER(S): BLM: CT6-40; MMS: 14-12-0001-29080.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1975; 1976; 1977.

COMPLETION DATE OF REPORT: August 1978.

COST(S): FY 1975: $3,930,264; FY 1976: $2,631,229; FY 1977: $3,606,303; CUMULATIVE PROJECT COST: $10,167,796.

PROJECT MANAGER(S): E. Mishuck.

AFFILIATION: Science Applications, Inc.

ADDRESS: P.O. Box 2351, 1200 Prospect Street, La Jolla, California 92037.

PRINCIPAL INVESTIGATOR(S)*: A. Bainbridge, A. Burlingame, T. Chow, P. Fischer, D. Hodder, O. Holm-Hansen, G. Jones, I. Kaplan, G. Knauer, W. Lippincott, M. Littler, P. Mankiewicz, J. Martin, B. Moberg, V. Orphan, W. Reed, R. Risebrough, R. Shokes, D. Straughan, S. Tafeen, J. Wilson.

KEY WORDS: Southern California; Southern California Bight; Tanner-Cortes Banks; baseline; intertidal; biology; photographimetric technique; community; trace metals; spectrophotometry; hydrocarbons; sediment; grain size; microbiology; subtidal; macrophytes; aerial photography; seasonality; faunal zones; coastal zone; recovery.

BACKGROUND: The marine biota present in the Southern California Bight represent a unique resource positioned at the northern reaches of the California biogeographic province. Intertidal studies on macrophytes and invertebrates of rocky shores within the Bight are relatively scarce. The quantitative data on intertidal and subtidal communities, particularly those of the offshore islands and banks, are limited. Investigations of the sandy beaches of the mainland coast have been made only recently, while beaches of the offshore islands have not been studied to any great extent. Chemical analyses, concentrating on trace metals and hydrocarbons, have also become more prevalent within the last several years, but no comprehensive characterization of the Southern California Bight has ever been undertaken. This program, initiated in 1975, represented the first comprehensive, multi-year characterization of the biological, chemical, and physical attributes of the intertidal and subtidal communities of the Bight.

OBJECTIVES: (1) To collect biological, chemical, and geochemical data pertinent to the Southern California Bight which will enable the Bureau of Land Management to address questions regarding the impacts of oil and gas activities on the marine environment; (2) To establish a basis for prediction of the potential impacts of these activities in frontier areas; and (3) To acquire impact data that may result in modification of leasing or operational regulations or operating orders.

DESCRIPTION: A total of 12 rocky intertidal sampling sites (seven island, five mainland locations) were occupied. Macrobiota standing stocks were assessed using the photographimetric technique, where two to four permanent transects were established at each site, oriented perpendicular to shore from high water to low water marks; approximately 40 permanent 0.15-m^2 quadrats and 40 permanent 1.0-m^2 quadrats were located on the transect lines at 1- to 3-m intervals; undisturbed samples consisted of two photographs of each quadrat taken for determination of percent cover by species. Disturbed sampling consisted of quantitative harvesting (wet, dry, and ash-free biomass). The mussel bed community study involved sampling at 11 sites (four mainland, seven island locations) with collections at high and low tide marks. Photographs were taken along with physical measurements. Five cores (300 cm^2 each) were removed from upper and lower intertidal portions of the bed. During rocky intertidal sampling, samples of the California mussel (Mytilus californianus), giant kelp (Macrocystis pyrifera), and black abalone (Haliotis cracherodii) were collected from nine sites for trace metal bioassay. Atomic absorption spectrophotometry (AAS) was used to analyze tissue samples for the presence of copper (Cu), chromium (Cr), cadmium (Cd), zinc (Zn), nickel (Ni), and lead (Pb). Neutron activation analysis (NAA) was used to determine barium (Ba), vanadium (V), and aluminum (Al) levels. Mytilus, used in the analysis of high molecular weight hydrocarbons (HMWHC) n-C_{12} (n-dodecane) to n-C_{32} (n-dotriacotane), was collected at nine intertidal sites.

Seventeen sandy beach and slough sites (11 mainland, 6 island beaches) were sampled. Undisturbed sampling (beach profile, aerial photography, recording other biota, physical measurements) was done quarterly at 4 sites, while 13 sites were sampled during summer and winter only. Disturbed sampling consisted of single-line transect sampling (0.03-m^2 cores excavated at three tide positions) and random quadrat sampling (three cylindrical cores, 7.7 cm in diameter, collected from each 3 x 3 m quadrat for infaunal analysis). Slough sampling consisted of 10 random core samples located within variably spaced quadrats positioned along a transect line. All cores were analyzed for grain size, moisture content, carbonate, and total organic carbon (TOC). Microbial biomass samples were collected at all beach locations. Trace metals and HMWHC analyses were completed on beach sediment samples (nine sites); the sand crab Emerita analoga was collected for tissue analysis at four of those sites. Trace metals were identical to those measured in the rocky intertidal program, with the addition of iron (Fe). All metals were measured by AAS or NAA. HMWHC analyses of Emerita tissue were identical to those employed in the rocky intertidal chemistry program.

The subtidal communities of Tanner-Cortes Banks were described based on four sampling visits to each of four sites during Year II. Photography, in situ observation, and disturbed sampling (similar to disturbed sampling of the intertidal) were done along two 30-m transects established at each site. The kelp bed analysis program evaluated the extent of mainland and island kelp beds (i.e., surface canopies) using aerial photography collected during eight surveys conducted between September 1975 and August 1977.

SIGNIFICANT CONCLUSIONS: During the second year of this study, data were gathered on 12 rocky intertidal, 17 beach and slough, and 4 shallow subtidal sites along the mainland and offshore island coasts of Southern California. In addition to characterizing the composition and seasonal variation of the flora and fauna of these sites, measurements were also taken of the trace metals and hydrocarbons present in the sediment and within the tissues of select organisms. In general, mainland areas, when compared to island sites, exhibited lower numbers of individuals and higher concentrations of hydrocarbons and trace metals. An aerial survey

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conducted along Southern California's coast indicated a historical decrease in the areal extent of kelp.

STUDY RESULTS: A total of 414 taxa (217 macroinvertebrate taxa, 197 macrophyte taxa) were recorded during rocky intertidal sampling. The extensive geographic variability between sites was confirmed with insular communities more lush and mature than mainland areas. Communities found associated with mussels were seasonally invariate (while rocky intertidal macrophytes exhibited seasonal die-backs), exhibited site and within-site specificity, and north-south biogeographic trends. Over 481 invertebrate taxa were recorded from the beds. Trace metal analyses indicated elevated levels of most metals for sites adjacent to harbors. Increases in HMWHC for sites adjacent to natural oil seeps and harbors were noted, but no concordant increases in trace metals were identified. Most island sites showed low levels of metals and HMWHC, although Cd was elevated in Mytilus and Emerita from San Nicolas Island. Macrocystis from San Nicolas, however, showed very low Cd levels. Elevated HMWHC levels were noted in winter samples of Mytilus from San Nicolas and mainland sites. Trace metal seasonality was not evident in Macrocystis but was in Mytilus.

Sandy beach community differences were related to beach physiography, tended to be distinctive for each site, and exhibited variability (within site) between the two years of sampling. The new site at Government Point exhibited the highest number of taxa and unique species. Sediment analyses indicated no variability between the two years of sampling; no seasonal variation in grain size; an aberrant increase in sediment coarseness at increasing tidal heights; low TOC; elevated levels of HMWHC from sites adjacent to natural oil seeps and on the mainland as compared to island sites; elevated HMWHC levels at lower tidal levels; and seasonally high (winter) HMWHC concentrations. Trace metals in Emerita were elevated only at Corona del Mar. HMWHC levels in the sand crab revealed the same seasonal and geographic trends seen in sediment samples.

Subtidal communities on the banks were characterized as a unique subset of mainland and insular species. Unusually high abundances of the hydrocoral Allopora were noted. Communities were depth- and substrate-dependent. Eisenia dominated the ridge top (<25 m), while Lithophyllum and Ophiothrix dominated the crust sites (>25 m). Mechanical disturbance resulted in rapid colonization by opportunistic species. Trace metal concentrations showed no geographic or seasonal trends. HMWHC were one or two orders of magnitude lower than in island intertidal specimens.

Variations in the areal extent and density of kelp, often as much as 50%, are not abnormal. Total surface area of kelp has decreased significantly since 1911, although total areal extent did not appreciably change in the study period (93 vs. 83 km^2). Local distribution is negatively affected by increases in temperature, turbidity, and wave/storm activity, as well as by grazing of predators.

STUDY PRODUCT(S): Lippincott, W. H. (ed.). 1978. Southern California Intertidal Baseline Study: Summary and Synthesis. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. Vols. I and II - NTIS No. PB-290740/AS. Contract No. AA550-CT6-40. 316 pp.

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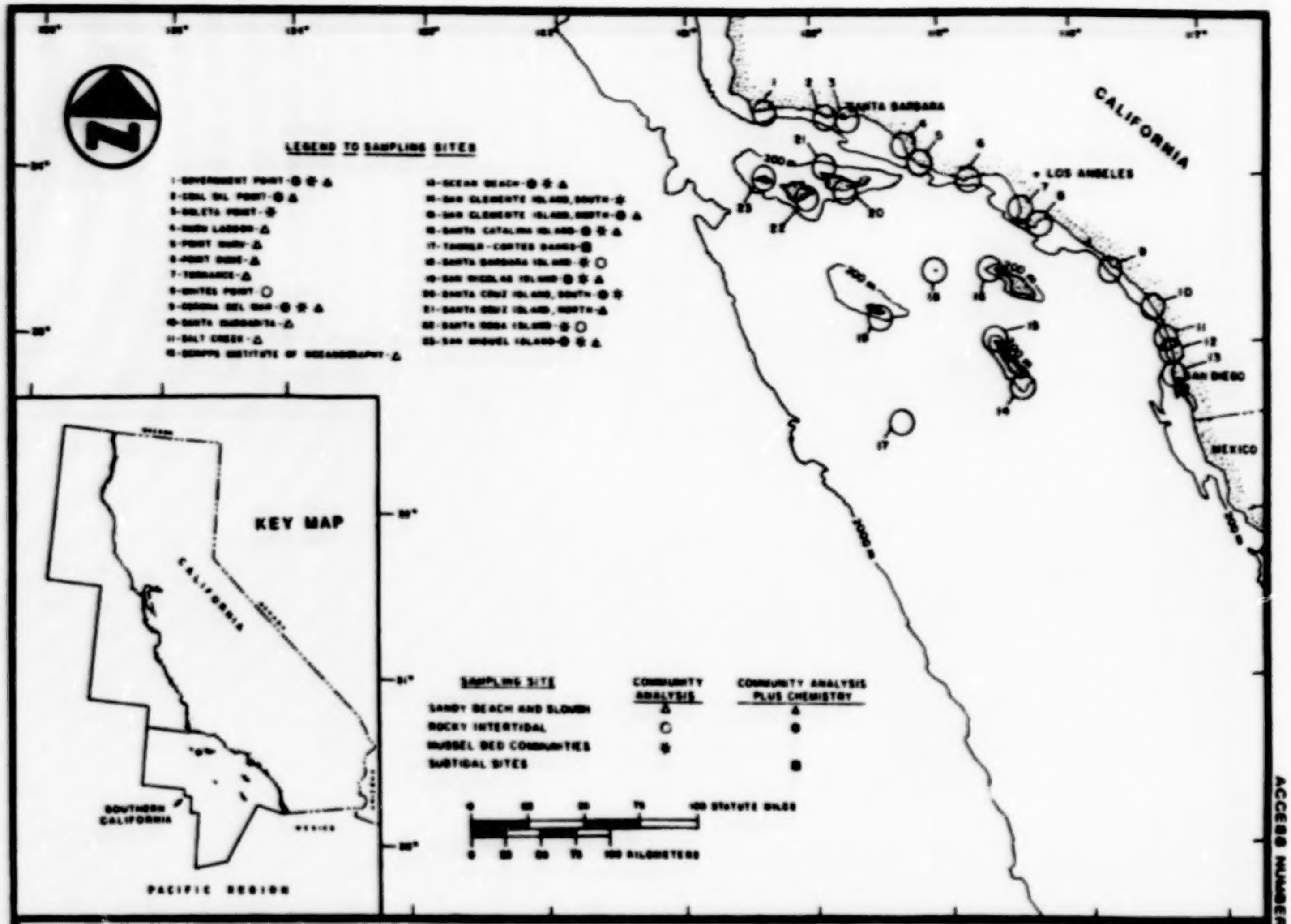

SAMPLING SITE LOCATIONS AND ANALYSES CONDUCTED DURING THE SOUTHERN CALIFORNIA INTERTIDAL BASELINE STUDY, YEAR II.

ACCESS NUMBER: 29080

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ACCESS NUMBER: **29080.2**

STUDY TITLE: Southern California Bight Intertidal Baseline Survey, Year II.

REPORT TITLE: Southern California Outer Continental Shelf Environmental Baseline Study 1976/1977 (Second Year) Benthic Program, Volume II, Report 4.0 - Hydrocarbon Determination in Southern California Bight Waters; Report 5.1 - Source and Depositional Controls of the High Molecular Weight Hydrocarbon Content of Surficial Sediments from the Southern California Outer Continental Shelf; Report 5.2 - Hydrocarbons in Dated Cores of Southern California Bight Sediments; Report 5.3 - Oil Pollution off the Coast of Southern California: Analysis of Hydrocarbons from Sediment Traps in San Nicolas, Santa Barbara, Santa Monica and San Pedro Basins; Report 6.0 - High Molecular Weight Hydrocarbons in Biota.

CONTRACT NUMBER(S): CT6-40; MMS: 14-12-0001-29080.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1976; 1977.

COMPLETION DATE OF REPORT: May 1979 (Reports 4.0, 5.1, 6.0); December 1978 (Reports 5.2, 5.3).

COST(S): FY 1976: $2,631,229; FY 1977: $3,606,303; CUMULATIVE PROJECT COST: $6,237,532.

PROJECT MANAGER(S): E. Mishuck.

AFFILIATION: Science Applications, Inc.

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PRINCIPAL INVESTIGATOR(S)*: A. Benson, J. Bonilla, S. Brenner, A. Burlingame, P. Crisp, B. deLappe, R. Jordon, I. Kaplan, E. Letterman, P. Mankiewicz, J. Nemmers, J. Payne, R. Risebrough, E. Ruth, J. Shropshire, W. Sistek, A. Springer, M. Venkartesan, W. Walker, II.

KEY WORDS: Southern California; Southern California Bight; baseline; biology; infauna; benthos; hydrocarbons; sediment; water column; geochronology; gas chromatography; spectroscopy; geochemistry.

BACKGROUND: Between 1975 and 1977, the U.S. Department of the Interior sponsored a multi-disciplinary program to provide an overview of the oceanographic environment and chemical, biological, and physical characteristics of intertidal and subtidal benthic environments off southern California. Preliminary (Year I) sampling was designed to provide a baseline data base. Subsequent sampling expanded upon Year I efforts and collected both additional characterization information and spatial-temporal data.

OBJECTIVES: (1) To determine spatial and temporal distributions of high molecular weight (HMW) hydrocarbons and related compounds in water and surficial sediments, with particular emphasis on relative amounts of biogenic and petrogenic components; (2) To determine historical input of HMW hydrocarbons to select submarine basins via analysis of age-dated sediment cores; (3) To describe the flux of hydrocarbons through the water column; and (4) To determine hydrocarbon levels in select benthic species to evaluate their potential as indicator organisms.

DESCRIPTION: For HMW hydrocarbon determinations in water, 90-liter seawater samples were collected from three depths (subsurface, midwater, bottom) at ten stations. Seasonal cruises were completed during February and August/September 1977 at two mainland (Coal Oil Point, Huntington Beach), three insular/bank (San Miguel Island, Santa Rosa Island, Tanner Bank), and five basin sites (Santa Barbara Basin, Santa Monica Basin, San Nicolas Basin, Santa Cruz Basin). Dissolved and particulate phases of hydrocarbons in seawater were determined via gas chromatography. For HMW hydrocarbon determinations in sediment, geochemical box core samples (209 samples from 48 benthic stations) were collected and the 0 to 1 and 1 to 2 cm intervals subsampled and frozen. Prior to analysis of the hexane (aliphatic hydrocarbons) and benzene (aromatic hydrocarbons) fractions via high resolution glass capillary gas chromatography, sediment samples were either freeze-dried or methanol-dried, soxhlet extracted for 72 hours using a 3:7 mixture (volume:volume) of toluene:methanol solvent, and the solvent then passed through an alumina/silica gel column.

Single age-dated core samples were collected from four basin sites (Santa Barbara Basin, San Pedro Basin, Santa Monica Basin, San Nicolos Basin) using a geochemical box core. Sediment cores were subsectioned into seven or eight vertical horizons, with each horizon dated by lead-210 and thorium-228 radioactivity analysis and x-ray examination. Hydrocarbon determinations were made following the methanol and toluene:methanol extraction process. Extracted solvent was analyzed via gas chromatography and mass spectroscopy.

Sediment traps consisted of an array of four stainless steel funnels (total collection area: 1 m^2) and were suspended 30 to 60 m above the seafloor at the same basin sites where age-dated cores were collected. Gas chromatographic analyses were completed on extracted solvents.

Benthic biota were collected via otter trawl at stations (depths: 72 to 270 m) far removed from major anthropogenic hydrocarbon inputs yet proximal (in some cases) to submarine oil seeps. Details of the molecular weight range and composition of hydrocarbon were determined by gas chromatography.

SIGNIFICANT CONCLUSIONS: Water column hydrocarbon levels for basin areas were equivalent to values reported in other outer continental shelf programs. Hydrocarbons derived from petrogenic (e.g., oil seep) and biogenic (e.g., biological) sources could not be differentiated. Surficial sediment samples exhibited elevated hydrocarbon levels near sewage outfalls, harbors, and natural oil seeps. Analysis of age-dated sediment cores indicated the presence of chlorinated hydrocarbons in the upper 50 mm of sediment, corresponding to the period 1945-1950 when DDT came into common use. Sedimentation and associated hydrocarbon deposition occurs at a greater rate in nearshore versus offshore basins. Select fish, crab, and shrimp species exhibited varying concentrations of hydrocarbon and chlorinated hydrocarbon contamination.

STUDY RESULTS: Water column hydrocarbon levels were generally <1 $ug\ l^{-1}$. Basin sites were characterized as showing a nearly uniform hydrocarbon composition and content through the water column. No distinctions between hydrocarbons derived from natural or man-made sources could be made.

Surficial sediment sample analyses revealed a predominance of anthropogenic or petroleum hydrocarbon contamination which varied geographically. Nearshore sites exhibited higher levels of chlorinated hydrocarbons and a greater degree of aromatic hydrocarbons from pyrolytic sources than offshore sites. Significant correlations of hydrocarbon levels with depth, sediment total organic carbon, and grain size were noted. Offshore samples exhibited high percentages of low molecular weight n-paraffins, attributed to marine plants. The other predominant biologic source (noted nearshore) was the cuticular waxes of higher terrestrial plants.

Age dated cores from San Pedro and San Nicolas Basins revealed decreasing hydrocarbon levels with increasing sediment depth. Chlorinated hydrocarbon residues were most prevalent in the upper 50 mm of San Pedro Basin sediments, while only traces were evident at the offshore site.

Sedimentation and petroleum hydrocarbon deposition rates for basins were correlated with proximity to municipal and industrial wastes and shipping activities. Petroleum hydrocarbon deposition rates followed the order: San Nicolas < Santa Barbara = Santa Monica < San Pedro, with the largest quantity of unweathered petroleum being deposited in San Pedro Basin.

Total hydrocarbon levels in shrimp (Pandalus) and crab (Lopholithodes) were lower and qualititatively different than for fishes. No correlations could be made between hydrocarbon concentrations and species, season, geographic location, sex, dry weight/liver weight or fresh weight.

STUDY PRODUCT(S): Science Applications, Inc. 1979. Southern California Outer Continental Shelf Environmental Baseline Study, 1976/1977 (Second Year) Benthic Program, Volume II - Technical Reports 1.0-10.0, 12.0-17.0. A final report for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. Contract No. AA550 CT6-40. NTIS No. PB80-166093/AS.

The previous citation represents a compendium of reports, each authored separately and covering a unique topic or area. Specific report numbers and titles, accompanied parenthetically by the respective author(s), are as follows:

Hydrocarbon Determination in Southern California Bight Waters. Report 4.0 (deLappe, B. W., R. W. Risebrough, J. C. Shropshire, E. F. Letterman, W. Sistek, A. M. Springer, and W. Walker III).

Source and Depositional Controls of the High Molecular Weight Content of Surficial Sediments from the Southern California Outer Continental Shelf. Report 5.1 (Mankiewicz, P., J. Nemmers, R. Jordon, J. Payne, I. R. Kaplan, M. I. Venkartesan, S. Brenner, and E. Ruth).

Hydrocarbons in Dated Cores of Southern California Bight Sediments. Report 5.2 (Kaplan, I. R., M. I. Venkartesan, S. Brenner, J. Bonilla, E. Ruth, and A. Burlingame).

Oil Pollution off the Coast of Southern California: Analysis of Hydrocarbons from Sediment Traps in San Nicolas, Santa Barbara, Santa Monica and San Pedro Basins. Report 5.3 (Kaplan, I. R., S. Brenner, M. I. Venkartesan, P. T. Crisp, and E. Ruth).

High Molecular Weight Hydrocarbons in Biota. Report 6.0 (Benson, A. A.).

*P.I.'s affiliation may be different than that listed for Project Manager(s).

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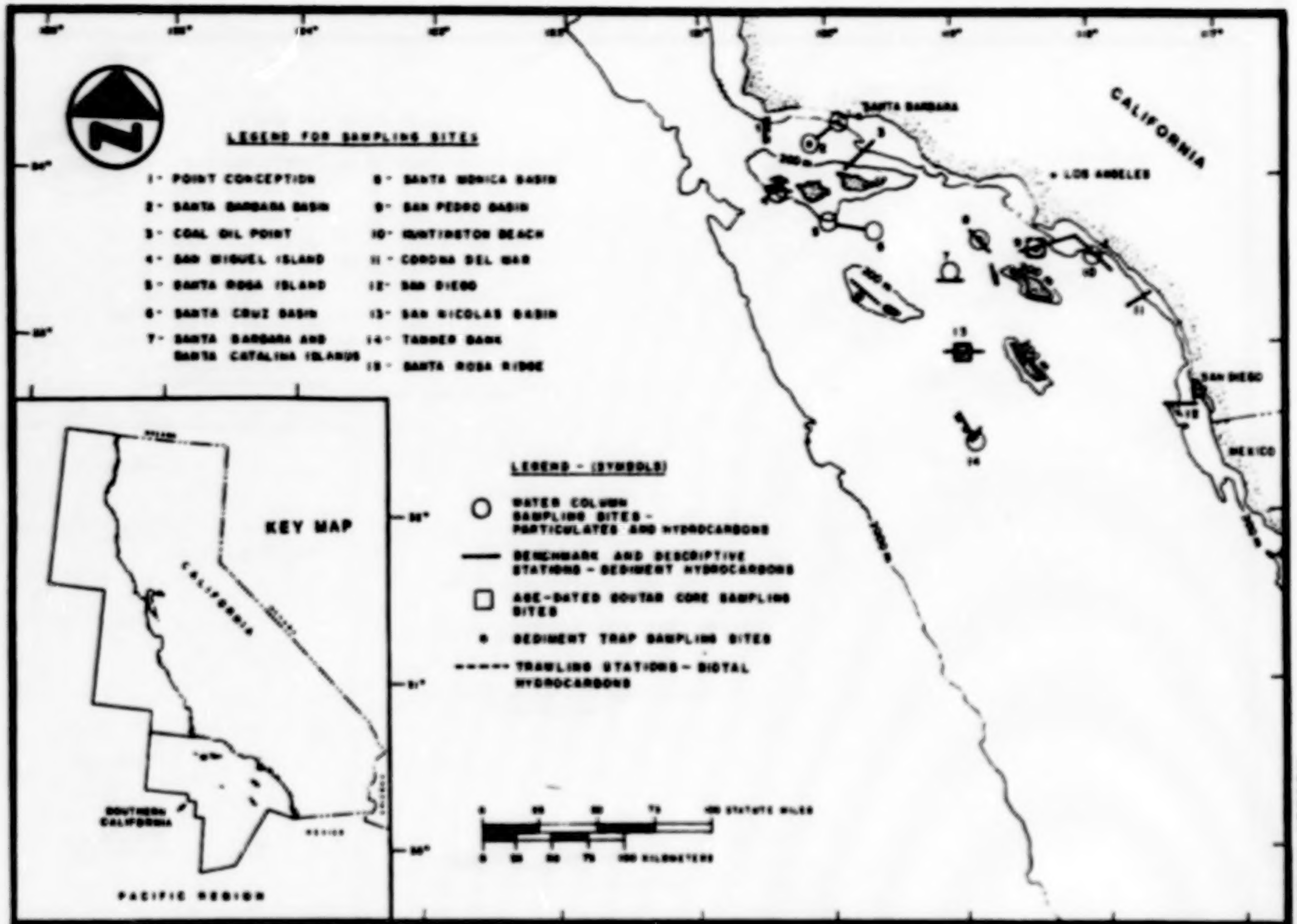

SAMPLING SITE LOCATIONS FOR THE SOUTHERN CALIFORNIA BASELINE STUDY, YEAR II.

ACCESS NUMBER:29080.2

ACCESS NUMBER: 29080.2

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ACCESS NUMBER: **29080.3**

STUDY TITLE: Southern California Bight Intertidal Baseline Survey, Year II.

REPORT TITLE: Southern California Outer Continental Shelf Environmental Baseline Study, 1976/77 (Second Year) Benthic Program, Volume II - Report 2.0 - Collection of Benthic Sediment Samples; Report 3.0 - Collection of Sediment Cores for Age, Date and Geochemical Analysis; Report 7.0 - Trace Metal Characterization of Water Column Particulates; Report 8.0 - Trace Metal Distributions in Southern California OCS Benthic Sediments; Report 9.0 - Vanadium, Barium and Other Trace Metals in Sediment and Biological Samples Using NAA; Report 10.0 - Trace Metals in Selected Benthic Marine Organisms; Report 12.0 - Age Dating of Box Cores; Report 13.0 - Collection of Pelagic Sediment Samples for Geochemical Analysis (PIT Deployment); Report 14.0 - Chronological Variations in Barium Concentration, Lead Concentration and Lead Isotopic Composition in Sediment of Four Southern California Offshore Basins; Report 15.0 - Sediment Texture and Organic Carbon Characterization in the Southern California OCS; Report 16.0 - Subtidal Benthic Sediment Analysis in the Southern California Bight - Bioturbation and Biogenic Sedimentary Structures; Report 17.0 - Characterization of Particle Interceptor Trap Samples by Scanning Electron Microscopy/X-Ray Energy Spectrometry; Report 24.0 - Natural and Anthropogenic Fluxes of Chemicals into the Southern California Bight as Related to the Potential Impacts of Offshore Drilling.

CONTRACT NUMBER(S): CT6-40; MMS: 14-12-0001-29080.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1976; 1977.

COMPLETION DATE OF REPORT: May 1979.

COST(S): FY 1976: $2,631,229; FY 1977: $3,606,303; CUMULATIVE PROJECT COST: $6,237,532.

PROJECT MANAGER(S): E. Mishuck.

AFFILIATION: Science Applications, Inc.

ADDRESS: P.O. Box 2351, 1200 Prospect Street, La Jolla, California 92037.

PRINCIPAL INVESTIGATOR(S)*: R. Anderhalt, D. Baxter, J. Bellows, K. Bruland, M. Butler, T. Chow, R. Franks, G. Knauer, W. Landing, P. Mankiewicz, J. Martin, A. Ng, V. Orphan, C. Patterson, W. Reed, T. Ronan, R. Shokes, J. Singleton, A. Soutar.

KEY WORDS: Southern California; Southern California Bight; baseline; trace metals; particulates; suspended matter; water column; sediment; fish; geochronology; grain size; hydrocarbons; geochemistry.

BACKGROUND: Between 1975 and 1977, the U.S. Department of the Interior sponsored a multi-disciplinary program to provide an overview of the oceanographic environment and the chemical, biological, and physical characteristics of the intertidal and subtidal benthic environments present off Southern California. Preliminary (Year I) sampling was generally designed to provide baseline data.

Subsequent sampling expanded upon Year I efforts and collected both additional characterization information and spatial-temporal data.

OBJECTIVES: (1) To determine the stratigraphic character of select Southern California Bight soft-bottom environments; (2) To characterize select trace metal levels in the water column (associated with suspended particulate matter), surficial sediments, and demersal fish species; (3) To age-date and provide time parameters for sediment cores from basins; (4) To determine sediment texture and organic carbon levels for nearshore and offshore sediments; (5) To determine physical and biogenic sedimentary structures of sediments and (6) To elucidate trace metal and hydrocarbon fluxes to several deep basins.

DESCRIPTION: Settling particulate material was collected using particle interceptor traps (PITs) with a 0.25 m^2 collecting surface area. PITs were deployed for 49 to 56 days (September/October 1977) in Santa Barbara, San Pedro, Santa Monica, and San Nicolas Basins. Samples were analyzed for uranium and thorium series radionuclides and trace metals. Suspended particulates and associated trace metals within the water column were also selectively determined based on seasonal collections (February 1977, August/September 1977; subsurface, midwater, and bottom depths) at 10 sites. Sediment samples for trace metal characterization and determination of physical properties were collected seasonally at 20 benchmark stations (6 replicates per station) and during a single season at 29 descriptive sites using a geochemical box core or grab sampler.

Levels of vanadium (V), barium (Ba), and several other metals in surficial sediments and tissues of stripetail rockfish (Sebastes saxicola) and slender sole (Lyopsetta exilis) were measured by instrumental neutron activation analysis and the barium sulfate radiochemical technique. Fish samples were collected seasonally at four locations ranging from mainland shelf to offshore bank.

Age dating of box core samples from three nearshore and one offshore basin was completed using stratigraphic dating procedures (x-ray identification, radiochemical treatment and analysis of thorium and lead isotope levels).

SIGNIFICANT CONCLUSIONS: Comparisons of suspended particulate matter with sediment data indicated that PIT samples adequately characterize sediment accumulation rates and composition. Suspended particulates in nearshore waters are contributed from onshore (terrigeneous clays, sewage) and nearshore (marine plants and animals) sources. Increases in sediment characteristics such as water content, total organic carbon, fineness, and trace metal levels were realized with increases in station water depth. Anthropogenic inputs represent the primary trace metal contributions to nearshore basins. Fish liver analysis revealed low trace metal levels which varied seasonally. Age-dated sediment analyses indicated significant contributions of lead from man's activities, particularly within recent time.

STUDY RESULTS: Methodologies and equipment for collection of undisturbed benthic sediment samples and cores for age dating and/or geochemical analysis were detailed in Reports 2.0 and 3.0. More high quality cores were collected in Year II as compared to Year I, attributed to increased competence and familiarity with operational procedures on the part of sampling personnel. Accumulation rates and chemical composition of PIT samples compared favorably to recently deposited sediments. Trace metals in suspended particulate material from surface waters are controlled by a terrigenous clay mineral component, a biological fraction, and a sewage particulate fraction.

Nearshore basin benthic sediment samples, in general, exhibited increased water content, total organic carbon, fineness, and trace metal concentrations with depth. Natural and anthropogenic inputs from the mainland strongly influence sediment character and trace metal levels in nearshore sediments. Offshore sediments of the outer shelves, banks, and basins exhibited lower metal levels than nearshore. Biogenic debris is the major source of sedimentation offshore.

Geographic differences in V, Ba, chromium (Cr), aluminum (Al), and iron (Fe) levels in surficial sediment samples were attributed to varying anthropogenic inputs. High carbonate offshore sediments were low in V, while nearshore clay-rich sediments exhibited high V levels. Ba levels related most closely with calcium carbonate. Low metal concentrations were characteristic of fish livers analyzed. Seasonality in metal levels was noted. Factors such as length, sex, maturity spawning cycle, geographic location, ecology, season, and stress were identified as important determinants in metal level fluctuations observed.

Age dating of inner basin sediments provided an undisturbed sequential sediment record at a resolution approaching one year. Measurements of lead (Pb) and Ba indicated that anthropogenic Pb concentrations increase with time. Natural depositional fluxes are higher than anthropogenic input in Santa Monica and Santa Barbara Basins, yet lower in San Pedro Basin. Trends in sediment characteristics were evident when data were separated into mainland and offshore groups. Mainland sediments are finer, contain less carbonate and more total organic carbon than offshore samples at equivalent depths.

STUDY PRODUCT(S): Science Applications, Inc. 1979. Southern California Outer Continental Shelf Environmental Baseline Study, 1976/1977 (Second Year) Benthic Program, Volume II - Technical Reports 1.0-10.0, 12.0-17.0. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. Contract No. AA550-CT6-40. NTIS No. PB80-166093/AS.

Science Applications, Inc. 1979. Southern California Outer Continental Shelf Environmental Baseline Study, 1976/1977 (Second Year) Benthic Program, Volume II - Technical Reports 18.0-24.0. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. Contract No. AA550-CT6-40. NTIS No. PB80-166101/AS.

The previous citation represents a compendium of reports, each authored separately and covering a unique topic or area. Specific report numbers and authors are as follows:

Report 2.0 - Soutar, A.; Report 3.0 - Soutar, A.; Report 7.0 - Bruland, K. W., R. P. Franks, and W. M. Landing; Report 8.0 - Earl, J. and T. J. Chow; Report 9.0 - Hansen, N., R. Sims, A. Abusanra, R. Shokes, J. Reed, and V. Orphan; Report 10.0 - Martin, J. H. and G. Knauer; Report 12.0 - Bruland, K. W., R. P. Franks, and J. D. Bellows; Report 13.0 - Soutar, A., J. Singelton, M. Butler, and J. Baxter; Report 14.0 - Ng, A. C. and C. C. Patterson; Report 15.0 - Anderhaldt, R. and W. E. Reed; Report 16.0 - Ronan, T. E., Jr. and J. Duncan; Report 17.0 - Soutar, A. and D. Baxter; Report 24.0 - Shokes, R. F. and P. J. Mankiewicz.

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*P.I.'s affiliation may be different than that listed for Project Manager(s).

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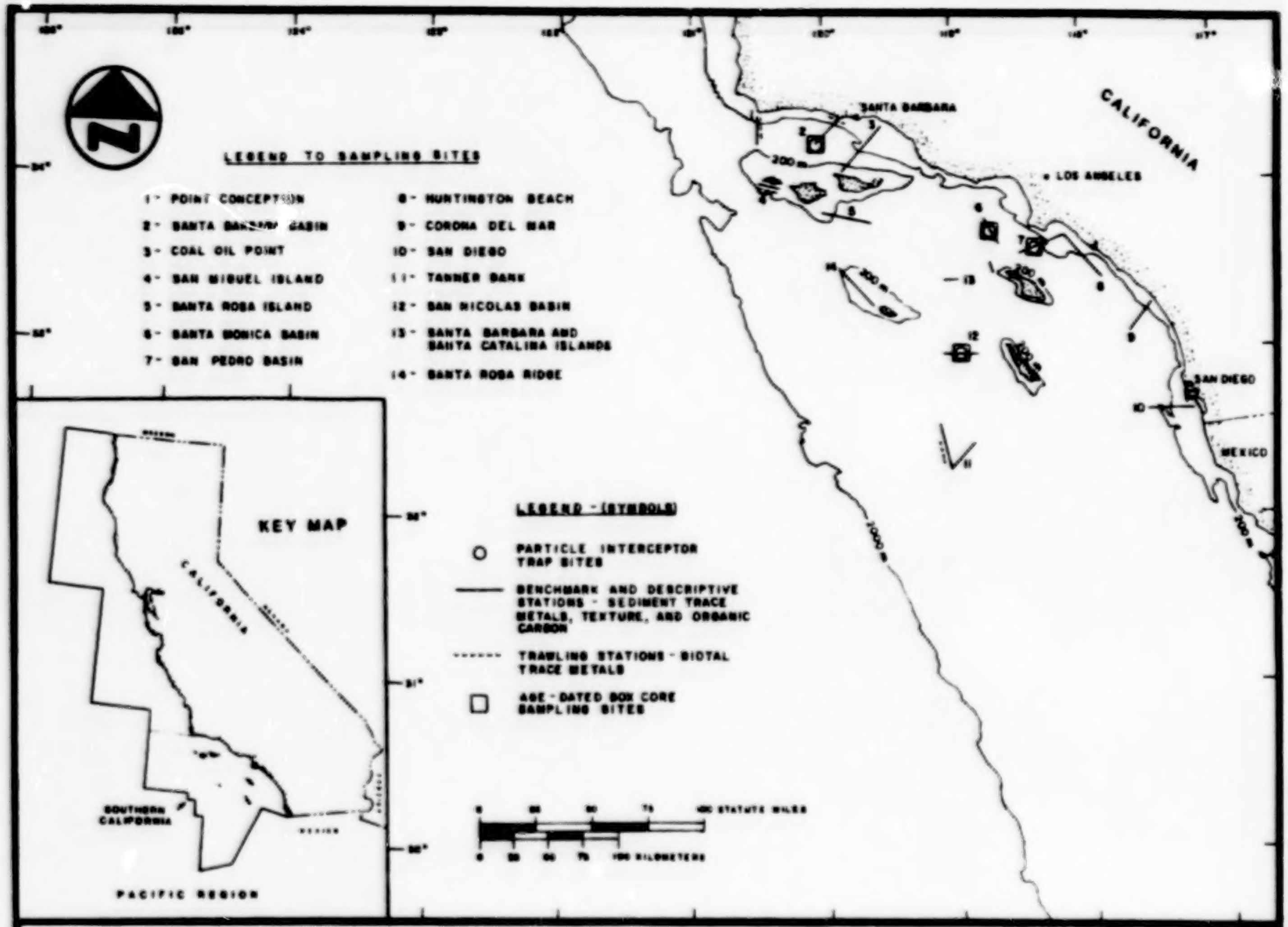

SAMPLING SITE LOCATIONS FOR THE SOUTHERN CALIFORNIA BASELINE STUDY, YEAR II.

ACCESS NUMBER: **29080.4**

STUDY TITLE: Southern California Bight Intertidal Baseline Survey, Year II.

REPORT TITLE: Southern California Outer Continental Shelf Environmental Baseline Study 1976/1977 (Second Year) Benthic Program, Vol. II - Report 18.0 - Variation in Community Structure of Shelf Slope and Basin Macrofaunal Communities of the Southern California Bight; Report 19.0 - A Survey of the Benthic Macrofauna at Six Additional Southern California Study Sites; Report 20.0 - The Influence of Sample Quality and Methods on the Recovery of Live Benthic Foraminifera in the Southern California Bight; Report 21.0 - Distributional and Variability Analysis of Benthic Foraminifera in the Southern California Bight; Report 22.0 - Health, Abundance and Diversity of Bottomfish and Shellfish Populations at Proposed and Existing Offshore Drilling Sites in the Southern California Bight; Report 23.0 - Biomass and Organic Carbon Determinations in the Water Column of the Southern California Bight.

CONTRACT NUMBER(S): BLM: CT6-40; MMS: 14-12-0001-29080.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1976; 1977.

COMPLETION DATE OF REPORT: May 1979.

COST(S): FY 1976: $2,631,229; FY 1977: $3,606,303; CUMULATIVE PROJECT COST: $6,237,532.

PROJECT MANAGER(S): E. Mishuck.

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PRINCIPAL INVESTIGATOR(S)*: R. Douglas, K. Fauchald, D. Holm-Hansen, G. Jones, A. Mearns.

KEY WORDS: Southern California; Southern California Bight; baseline; biology; infauna; benthos; epifauna; seasonality; microbiology; particulates; foraminifera; fish; water column; shelf; slope; faunal zones; diversity.

BACKGROUND: With the beginning of oil and gas lease sales in the Southern California Outer Continental Shelf (OCS), environmental baseline studies were begun in 1975 by the U.S. Department of the Interior to describe and quantify the chemical, geological, and biological characteristics of the area. The primary purpose of the studies was to provide the data necessary to make sound management decisions and to assign probable cause in event of environmental changes associated with resource development. The present report describes the benthic studies for the second year (1976-77) of the program.

OBJECTIVES: (1) To analyze the spatial and temporal variations in the benthic community (i.e., macrofauna, microfauna, fishes); and (2) To determine the distribution of particulate organic carbon, dissolved organic carbon, and microbial biomass.

DESCRIPTION: Benthic macrofauna were collected from 21 benchmark sites during winter and summer and at 52 descriptive sites during winter using a 1/16 m^2 USNEL box core. Eight replicate samples were taken at the benchmark sites (318 total samples) with single box cores collected at the descriptive sites. Thirty-seven replicate summer samples and 26 replicate summer and winter samples were collected for Foraminifera (microfauna). Thirty-one otter trawl samples (16 winter samples, 15 summer samples), two rock dredge samples, and one beam trawl sample were used to collect 12,400 shellfishes and bottom fishes at four locations in the study area.

For microbial biomass determination, 10 stations were seasonally occupied. Niskin bottles were used to collect water samples at surface, midwater, and bottom depths. Subsamples destined for particulate organic carbon determinations were filtered through Whatman glass fiber filters. Dissolved organic carbon subsamples were frozen. Particulate and dissolved organic carbon determinations were made via wet oxidation followed by infrared measurement of the liberated CO_2. Microbial biomass was based on adenosine triphosphate (ATP) measurements; ATP subsamples were filtered (micro-fine glass fiber filters) and extracted by immersion in boiling buffer (Tris). Extracted ATP determinations were made via the bioluminescent technique.

SIGNIFICANT CONCLUSIONS: Benthic macrofauna can be differentiated into mainland shelf, slope, ridge and bank, and basin communities. Deposit feeders (both surface and subsurface) dominate the randomly distributed communities. Fish and shellfish communities tend to be generally healthy although they harbor external and internal parasites. Gill and liver damage in bottom fishes at Coal Oil Point may be due to oil seeps in the area although no definite relationship was established. No cause is attributed to presence of epidermal tumors in three fish species. Foraminifera are influenced by various abiotic factors which include seasonality, water quality, substrate type, and wave and current energies. Seasonal (summer) elevations in particulate organic carbon and ATP correlations were noted in the upper 50 m of the water column, while below 100 m particulate organic carbon values were quite similar regardless of season. Future evaluations of organic carbon (particulate and dissolved) and microbial biomass should be conducted at an increased number of sites, as too few stations were occupied to draw significant conclusions.

STUDY RESULTS: Mainland shelf benthic communities were characterized by large, homogeneous assemblages with randomly dispersed fauna dominated by surface deposit feeders (specifically the ophiuroid Amphiodia urtica). Seasonal differences in winter and summer populations were evident. Benthic populations at slope sites could be differentiated into upper and lower slope communities. Species characteristic of the upper slope also occurred at deeper locations on the slope while the lower slope species were generally restricted to these sites. The fauna were randomly dispersed, and dominated by subsurface deposit feeders. However, no evidence of seasonality was observed. Ridge and bank fauna formed a patchy mosaic of four assemblages including three ophiuroid assemblages and one polychaete assemblage. High diversity and an indication of seasonality were noted for these areas. Basins were characterized by distinct faunal groups that were randomly dispersed and dominated by surface deposit feeders. There was no evidence of seasonal variability. These patterns were considered preliminary given the existence of only one summer and one winter sampling.

Data collected at the descriptive sites were described as inconclusive and useful only as preliminary indicators of faunal assemblages of the study area. In general, numbers of organisms and species diversity appeared to be depth-related. A shallow shelf assemblage was restricted to sandy substrates in water depths of 20 m or less. This assemblage was characterized by the dominance of the pelecypod Tellina carpenteri and the gastropod Olivella baetica. The other major community was the Amphiodia urtica assemblage, the dominant macrofaunal community of the Southern California mainland shelf.

At least 268 species of elasmobranchs, fishes, echinoderms, crustaceans, and other species were collected in the trawl samples at Tanner Bank, San Miguel Island, Pt. Conception, and Coal Oil Point. The bottomfish and shellfish assemblages are similar to those found elsewhere in Southern California at similar depths. Site-specific differences which were observed included larger populations and proportions of flatfishes, rockfishes, shrimps, and echinoderms at mainland shelf sites than offshore sites.

External examinations suggested that fishes at all sites were healthy. One to five percent, however, had external parasites, tumor-like cysts, and color anomalies; up to 75% had an apparently normal load of small and microscopic parasites. At least three fish species were inflicted with epidermal tumor diseases, the cause of which is unknown. No effects on fish and invertebrate species composition or community structure were observed from oil seeps at Coal Oil Point. However, a higher incidence of liver and gill tissue damage at this site compared to other sites may be related to oil exposure.

Foraminifera diversity and numbers were lowest in the bank regions with the highest diversity in continental and insular shelf regions. The highest numbers of organisms were found in the basins. Sand and gravel substrates and increasing wave and current energies decreased foram diversity. Diversity increased with depth in well-oxygenated areas and in fine-grained substrates at low oxygen levels. Ranges in seasonal patterns of diversity and abundances were greatest in nearshore regions and decreased offshore. Mainland, insular shelf, and Tanner Bank-Cortes Ridge foram communities were similar due to common water quality. Slope and basin sites, which are characterized by lower temperature and oxygen and a higher salinity than the above sites, supported a second foram assemblage.

Particulate organic carbon values for the 10 sites sampled were high (50 to 300 ng l^{-1}) within the upper 50 m of the water column. Due to a lack of multiple level sampling within the euphotic zone of each station, none of the gradients identified in previous studies (e.g., phytoplanktonic biomass and photosynthetic activity variations within the euphotic zone and/or from shallow to deeper water) were readily identifiable. Particulate organic carbon and ATP from the upper 50 m varied seasonally, with higher figures in summer. Below 100 m depth, particulate organic carbon values were reasonably constant (5 to 15 ng l^{-1}) year round, reflecting the steady-state flux of particulates settling out from the productive euphotic zone.

STUDY PRODUCT(S): Science Applications, Inc. 1979. Southern California Outer Continental Shelf Environmental Baseline Study, 1976/1977 (Second Year) Benthic Program, Vol. II - Technical Reports, Series 2; Reports 18-24. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB80-166101/AS. Contract No. AA550-CT6-40. 609 pp.

*P.I.'s affiliation may be different than that listed for Project Manager(s).

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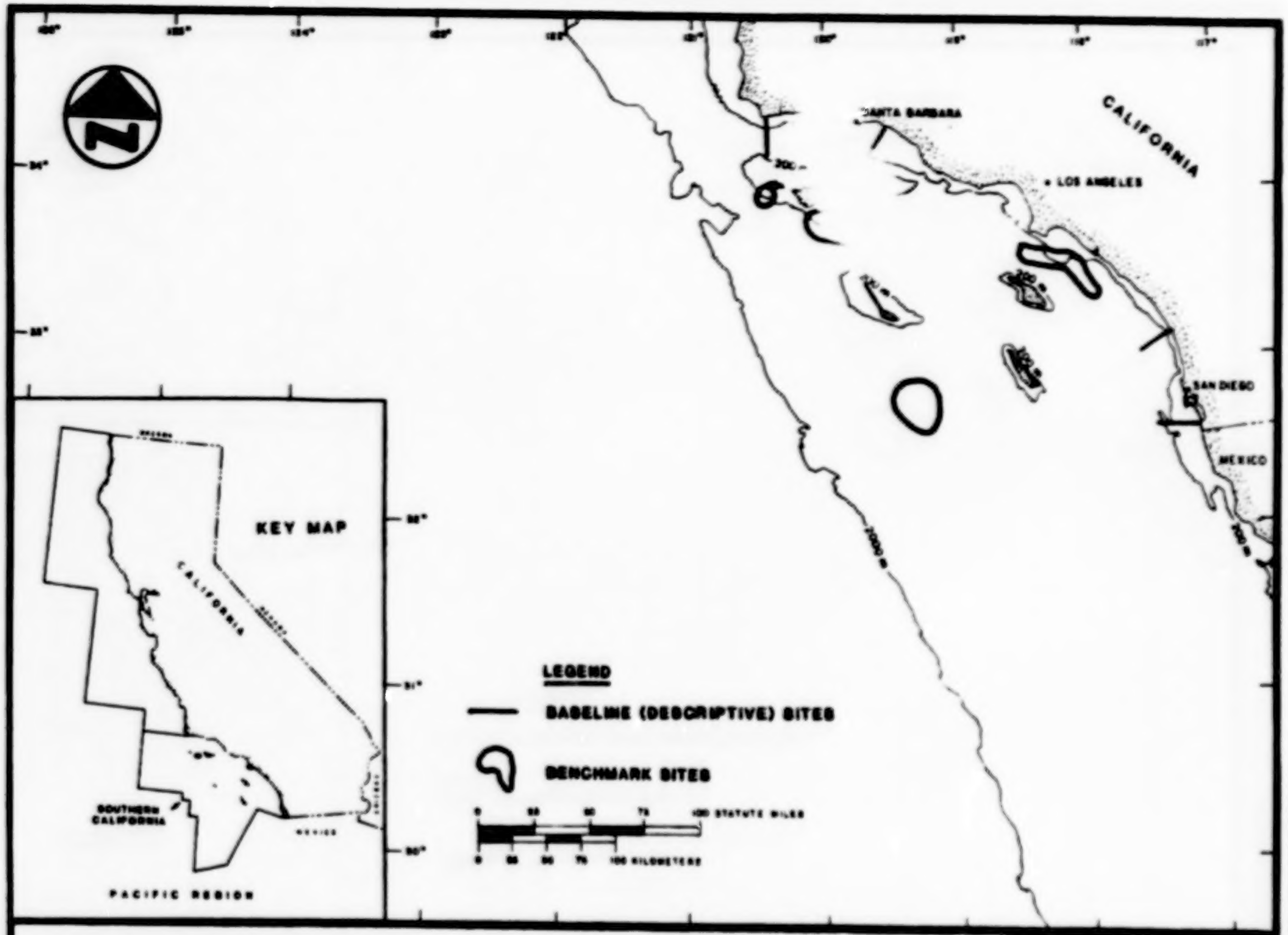

SAMPLING SITE LOCATIONS FOR THE SOUTHERN CALIFORNIA BASELINE STUDY, YEAR II.

ACCESS NUMBER: 29080.4

ACCESS NUMBER: **29080.5**

STUDY TITLE: Southern California Bight Intertidal Baseline Survey, Year II.

REPORT TITLE: Intertidal Study of the Southern California Bight 1976/1977 (Second Year) Vol. III, Report 1.1 - Rocky Intertidal (Report Sections 1.1.1 to 1.1.7, 1.1.8 to 1.1.13, and 1.1.18 to 1.1.22).

CONTRACT NUMBER(S): BLM: CT6-40; MMS: 14-12-0001-29080.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1976; 1977.

COMPLETION DATE OF REPORT: November 1978.

COST(S): FY 1976: $2,631,229; FY 1977: $3,603,303; CUMULATIVE PROJECT COST: $6,237,532.

PROJECT MANAGER(S): E. Mishuck.

AFFILIATION: Science Applications, Inc.

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PRINCIPAL INVESTIGATOR(S)*: M. Littler.

KEY WORDS: Southern California; Southern California Bight; baseline; biology; intertidal; distribution; photographimetric technique; seasonality; diversity; macrophytes.

BACKGROUND: This report is the synthesis of the first two years of comprehensive investigations into the following three programs of study: (1) taxonomic and systematic studies of the macroepibiota; (2) determinations of seasonal and yearly distribution and abundance patterns in standing stocks; (3) temporal and spatial analysis of community organization. The method of obtaining undisturbed samples provided a powerful tool for quantification of seasonal and yearly differences in the biota and this is emphasized throughout the report.

OBJECTIVES: (1) To establish quantitatively reliable and reproducible baseline determinations of variations in the abundance and distributional patterns of rocky intertidal and subtidal organisms at selected regions of the Southern California Bight; and (2) To relate biological variability with possible causal mechanisms.

DESCRIPTION: For the baseline portion of the study, 12 intertidal study sites were selected at or near the following Southern California Bight locations: Corona del Mar, Santa Catalina Island, Santa Barbara Island, Coal Oil Point, Ocean Beach, Whites Point, San Nicolas Island, Santa Cruz Island, San Miguel Island, San Clemente Island, Santa Rosa Island, and Government Point.

The primary method of sampling the intertidal standing stocks of macroorganisms was a photographimetric technique which was described in detail in the Year I report. This method yields parallax-free samples that are used to generate detailed and reproducible quantitative information. The method is simple and rapid, and through the use of various films can emphasize healthy or unhealthy plant materials. Changes due to natural causes or perturbation can be demonstrated by direct comparison of photo-samples of identical quadrats over different sampling periods. This "undisturbed" type of sampling was accomplished quarterly at all 12 of the intertidal study sites. "Disturbed" type sampling (harvest sampling) was performed quarterly at only three sites: Coal Oil Point, Government Point, Santa Rosa Island. Areas covered by disturbed and undisturbed sampling were 0.15 and 1.0 m^2. The method of disturbed type sampling is described in the Year I report. Analysis of data for each area was generally accomplished using standard parameters (percent coverage, density of invertebrates, percent frequency of presence, wet weight, dry weight) and community statistics (Shannon-Weaver diversity index, evenness, richness, and cluster analysis).

SIGNIFICANT CONCLUSIONS: (1) Baseline ecological assessments of rocky intertidal biota at 12 study sites and of rocky subtidal biota at four sites in the Southern California Bight led to determinations of spatial and temporal variability of the dominant intertidal populations; assessments of the effects of catastrophic events on rocky intertidal populations and community structure; community perturbation and recovery analysis at 12 intertidal and 4 subtidal sites; and the comparative growth of selected macrophytes in oil stressed communities. (2) The study provides an in-depth, integrated approach to the generation of basic information concerning the ecology of the rocky intertidal communities in the Southern California Bight and insight into the possible perturbation effects on these communities from offshore development of oil and gas resources.

STUDY RESULTS: A total of 414 taxa were recorded during the second year from all the study areas. The number of macrophyte taxa (197) was about equal to the number of macroinvertebrate taxa (217). Over half of the macrophyte taxa recorded were Rhodophyta, but Phaeophyta were the major contributor of the biomass. Of the macroinvertebrates, gastropods comprised the most taxa (104), but the California mussel was by far biomass dominant.

Community data accumulated during Year II corroborated the principal findings of the first year with only minor exceptions. The most significant new information was obtained by the addition of new sites at Government Point and Santa Rosa Island. The Government Point site is unusual owing to the prevalence of mixed species assemblages; more macrophyte taxa were recorded there than at any other site. As in Year I, the island sites were dominated by forms associated with mature communities. The substrate heterogeneity of San Nicolas Island is matched by a mosaic of mature and opportunistic communities.

While sand scouring is common to most of the sites, the most affected sites are Coal Oil Point and San Nicolas Island where the invertebrate dominated upper intertidal is replaced by sandy beach. The shifting boulder substrate at Corona del Mar constitutes another type of natural perturbation resulting in proliferation of opportunistic species.

Studies of succession following experimental and natural perturbation suggest that: (1) opportunistic species recovery would be fastest, (2) macrophytes are the more responsive following disturbance than macroinvertebrates, (3) the lower intertidal would need to recover first, (4) recovery of some species by new recruitment is more likely than by encroachment from undisturbed areas. The first of these observations further suggest that recovery patterns following petroleum-related disturbance should be substantially different at sites dominated by immature communities than at those with zonally developed mature communities. The results of this program suggest that the island sites are distinct from the mainland sites, especially regarding the lower intertidal where intersite variability is the greatest. The island means (among sites) were substantially greater than those on the mainland with respect to percent cover and biomass. This indicates that the islands are more lush than the mainland, and this is consistent with the hypothesis that anthropogenic pollution sources have caused long-term reductions in the algal flora on the mainland.

STUDY PRODUCT(S): Science Applications, Inc. 1978. Intertidal Study of the Southern California Bight--1976/1977. Vol. III, Reports 1.1.1-1.1.7, 1.1.8-1.1.13, and 1.1.18-1.1.22. A final report for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. Report sections 1.1.1-1.1.7 - NTIS No. PB300344/AS; Report sections 1.1.8-1.1.17 - NTIS No. PB300[illegible]/AS. Contract No. AA550-CT6-40. 3 Volumes.

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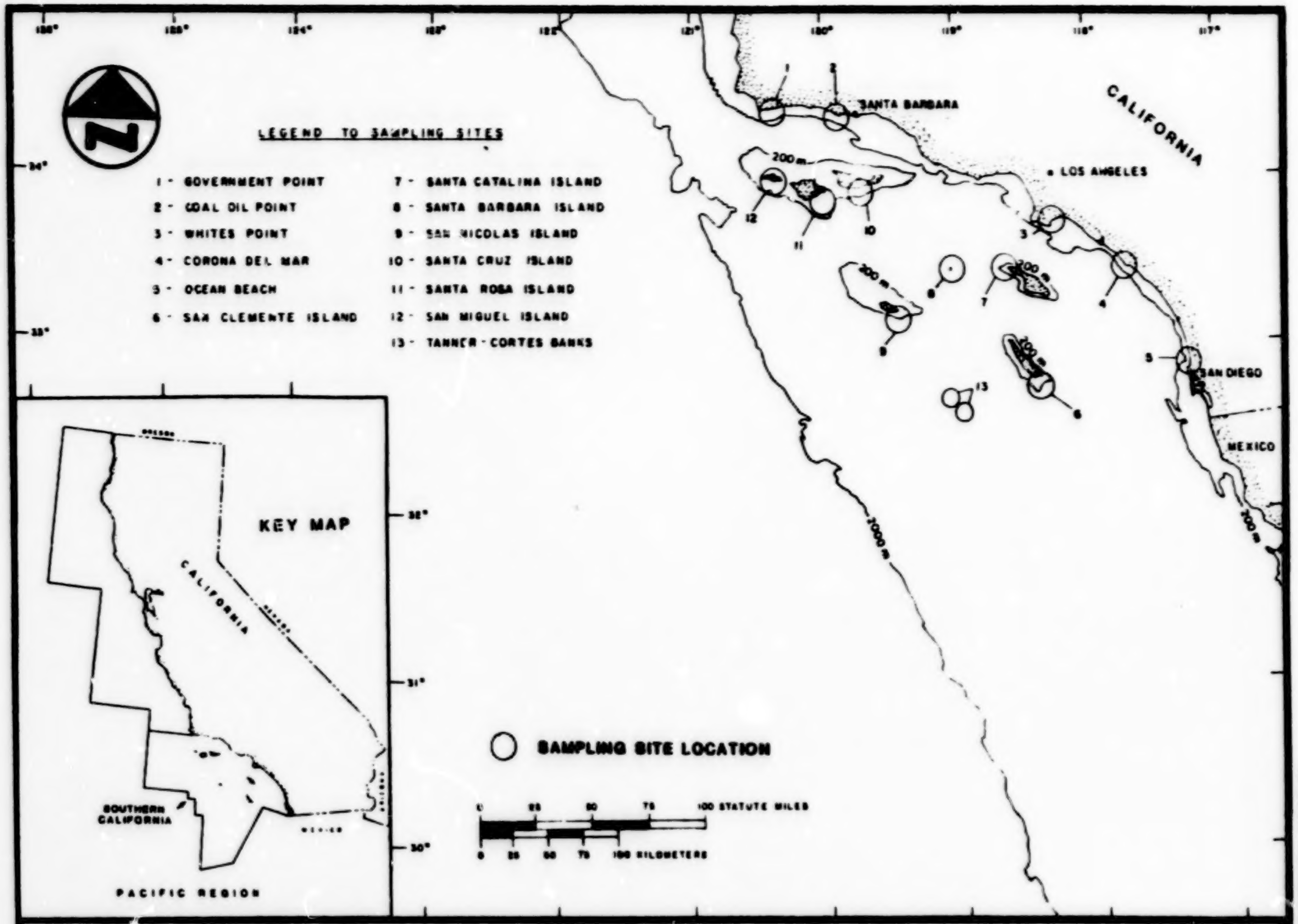
* P.I.'s affiliation may be different than that listed for Project Manager(s).



SAMPLING SITE LOCATIONS FOR THE SOUTHERN CALIFORNIA BASELINE STUDY, YEAR II.

ACCESS NUMBER: 29080.5

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ACCESS NUMBER: **29080.6**

STUDY TITLE: Southern California Bight Intertidal Baseline Survey, Year II.

REPORT TITLE: Intertidal Study of the Southern California Bight, 1976/1977 (Second Year), Vol. III, Report 1.2 - Mussel Community Studies; Report 1.3 - Sandy Beach/Slough; Report 1.4 - Kelp Survey of the Southern California Bight.

CONTRACT NUMBER(S): BLM: CT6-40; MMS: 14-12-0001-29080.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1976; 1977.

COMPLETION DATE OF REPORT: November 1978.

COST(S): FY 1976: $2,631,229; FY 1977: $3,606,303; CUMULATIVE PROJECT COST: $6,237,532.

PROJECT MANAGER(S): E. Mishuck.

AFFILIATION: Science Applications, Inc.

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PRINCIPAL INVESTIGATOR(S)*: D. Hodder, R. Kanter, M. Mel, D. Straughan.

KEY WORDS: Southern California; Southern California Bight; baseline; biology; intertidal; mussel; Mytilus; kelp; Macrocystis; sandy beach; distribution; slough; aerial photography.

BACKGROUND: The U.S. Department of the Interior sponsored benchmark studies on several aspects of the Southern California coastal environment. Of the components investigated, this document contains results from Year II (1976-1977) investigations of mussel communities and sandy beaches and sloughs. In addition, the results from two years of remote sensing of kelp beds are presented.

OBJECTIVES: (1) To determine spatial and temporal distribution of biotic communities in mussel beds and sandy beaches and sloughs; (2) To provide statistically reliable baseline data for the intertidal zone; and (3) To delineate areal coverage of kelp beds from infrared aerial imagery maps.

DESCRIPTION: Mussel (Mytilus californianus) communities were sampled from four mainland sites (Government Point, Goleta Point, Corona del Mar, and San Diego) and seven island sites (San Miguel, Santa Rosa, Santa Cruz, Santa Barbara, Santa Catalina, San Nicolas, and San Clemente Islands). At each locality, five cores (300 cm) were removed from a 1,500-cm area in both upper and lower intertidal areas. Air, water, and mussel bed temperatures as well as bed thickness were recorded during each sampling period at each locality. Samples were sorted and organisms were identified to the lowest possible taxon. Sediments, detritus, and debris were removed from samples and analyzed. Residual volume (intermussel space) was determined using water displacement. Optimal sample sizes were determined from species-area curves. Community structural parameters were derived using diversity, evenness, and richness indices. Numerical classification was employed for objective site and community comparisons. Multiple discriminant analysis was performed to assess relationships between community similarity and abiotic variables. Eighteen sandy beach sites were sampled during 1976-1977.

Most sites were sampled biannually (summer and winter) using disturbed and undisturbed methods. Disturbed sampling included single line transects and stratified random cores (10 replicates) from high to low tide marks at each locality. Cores (7.7 cm diameter) were collected for biological composition and sediment analyses. Sediment samples were analyzed for grain size distribution, moisture content, and total organic carbon. In sloughs, discontinuous series of quadrats were sampled with a 25.4-cm diameter corer at randomly selected points and along a transect. From September 1975 to August 1977, eight aerial surveys, photointerpretation, mapping and computer processing for all known and historic kelp (Macrocystis) beds between Point Conception and the Mexican border, including the eight principal Channel Islands were conducted. Aerial imagery was ground truthed qualitatively and quantitatively by diver photography and collections at sites where imagery was available.

SIGNIFICANT CONCLUSIONS: Mussel communities were diverse and contained 544 faunal and floral species. Santa Cruz Island and Corona del Mar supported the most diverse mussel communities while Goleta Point was the least diverse of the sampled localities. Similarity analyses revealed a north-south pattern in community similarity. Northern and southern groups included both island and mainland localities. Future studies should include an intensive sampling program at one site, incorporation of hydrographic data, random process for selection of sampling areas, and addition of a collection area north of Point Conception. Sandy beaches yielded 370 plant and animal species. Government Point was the richest open coast community. Beach profile, grain size, rain fall, and ocean currents all contributed to variations in species distributions. Petroleum contamination was possible at the Twin Harbors site. Species distributions in the sloughs were related to distinctive salinity regimes within each slough. Kelp bed size and configuration varied in time and space. Local factors such as wave energy, temperature, grazing, sedimentation, canopy succession, recolonization, and harvesting affect kelp bed areas.

STUDY RESULTS: The total species list from all mussel communities included 481 animal species and 63 algal species. Corona del Mar and Santa Cruz Island supported the richest communities with 119 and 120 species, respectively. Mussel beds at Goleta Point were depauperate, containing only 57 species; however, these communities were unique in species composition and abundance. Mussel communities separated along a north-south pattern of community similarity, presumably the result of differential larval recruitment to settlement sites. Microhabitat complexity was responsible for variation in species diversity. Tar was a significant physical factor in all mussel communities. Sandy beaches had 350 animal species and 20 plant species. Faunal assemblages were numerically dominated by annelids, arthropods, and molluscs. In general, site-specific physical environmental variables dictated community composition. Steep, coarse-grained beaches were characterized by few species and individuals while long, gently sloping, fine-grained beaches supported rich and abundant communities consisting primarily of polychaetes. Tar impact was possible at the Twin Harbors site. The Government Point site represented a zoogeographic boundary. The three mainland sloughs and the Twin Harbors locality all exhibited distinct biota. Slough community differences were related to unique salinity regimes within each site.

A total of 58 maps (scale 1:24,000) were prepared for kelp bed delineation. Annual and seasonal fluctuations in the area covered by kelp, varied geographically and temporally depending on local and regional environmental parameters, particularly on wave conditions and water temperatures. Colonization of new areas or areas denuded by catastrophic storms required six months to a year for canopy formation. Kelp beds along open coastlines fluctuated less than kelp beds in protected areas. Variations in areal extent of kelp beds were between 10 to 35%; however, kelp beds in the region extending from Santa Barbara to Point Conception were relatively constant in areal fluctuation (10 to 15%).

STUDY PRODUCT(S): Kanter, R. 1978. Mussel Community Studies. In: Intertidal Study of the Southern California Bight, 1976/1977 (Second Year), Vol. III, Report 1.2. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB300348/AS. Contract No. 08550-CT6-40.

Straughan, D. 1978. Sandy Beach/Slough. In: Intertidal Study of the Southern California Bight, 1976/1977 (Second Year), Vol. III, Report 1.3. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB300348/AS. Contract No. 08550-CT6-40.

Hodder, D. 1978. Kelp Survey of the Southern California Bight. In: Intertidal Study of the Southern California Bight, 1976/1977 (Second Year), Vol. III, Report 1.4. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB300348/AS. Contract No. 08550-CT6-40.

* P.I.'s affiliation may be different than that listed for Project Manager(s).

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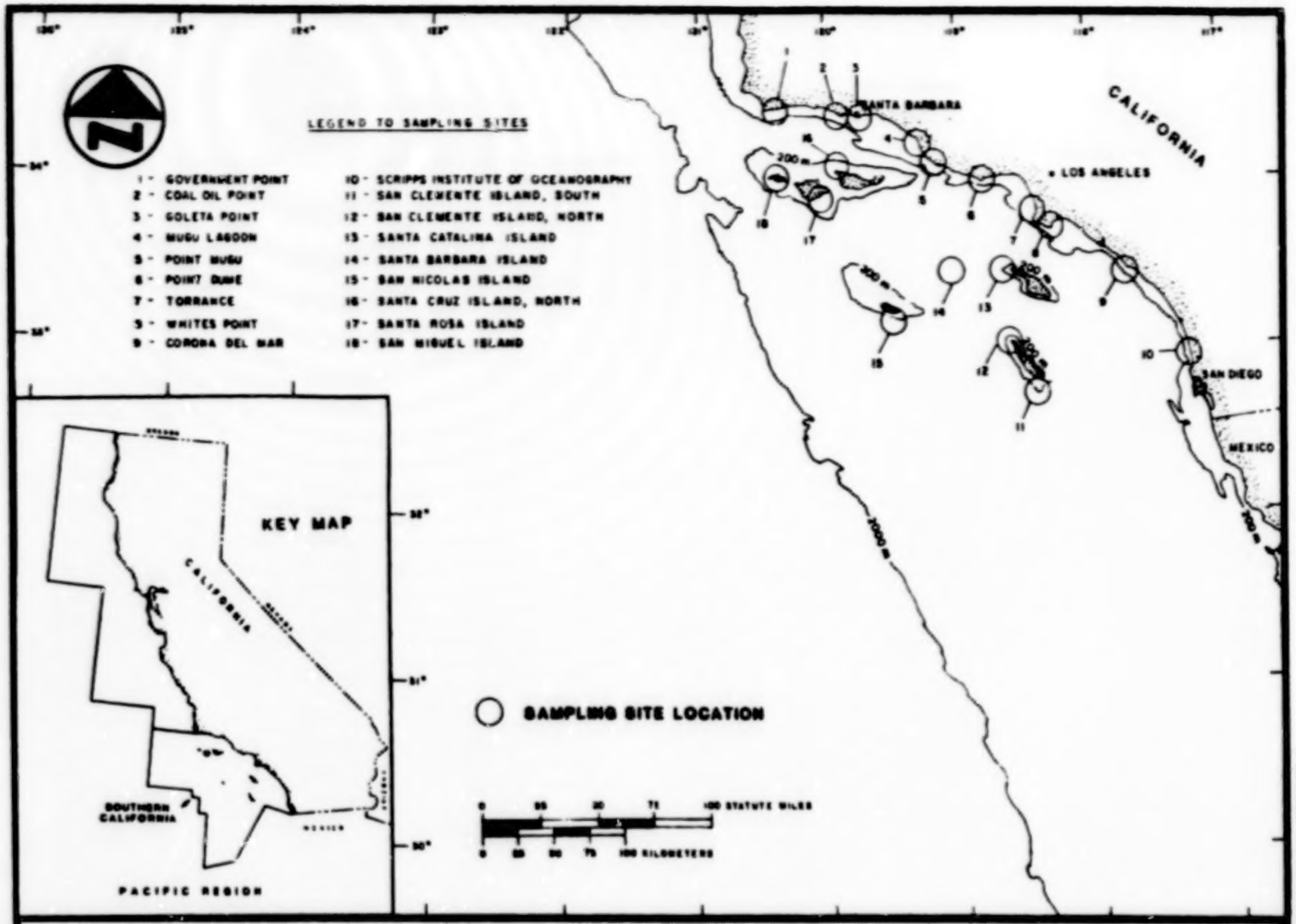

SAMPLING SITE LOCATIONS FOR THE SOUTHERN CALIFORNIA BASELINE STUDY, YEAR II.

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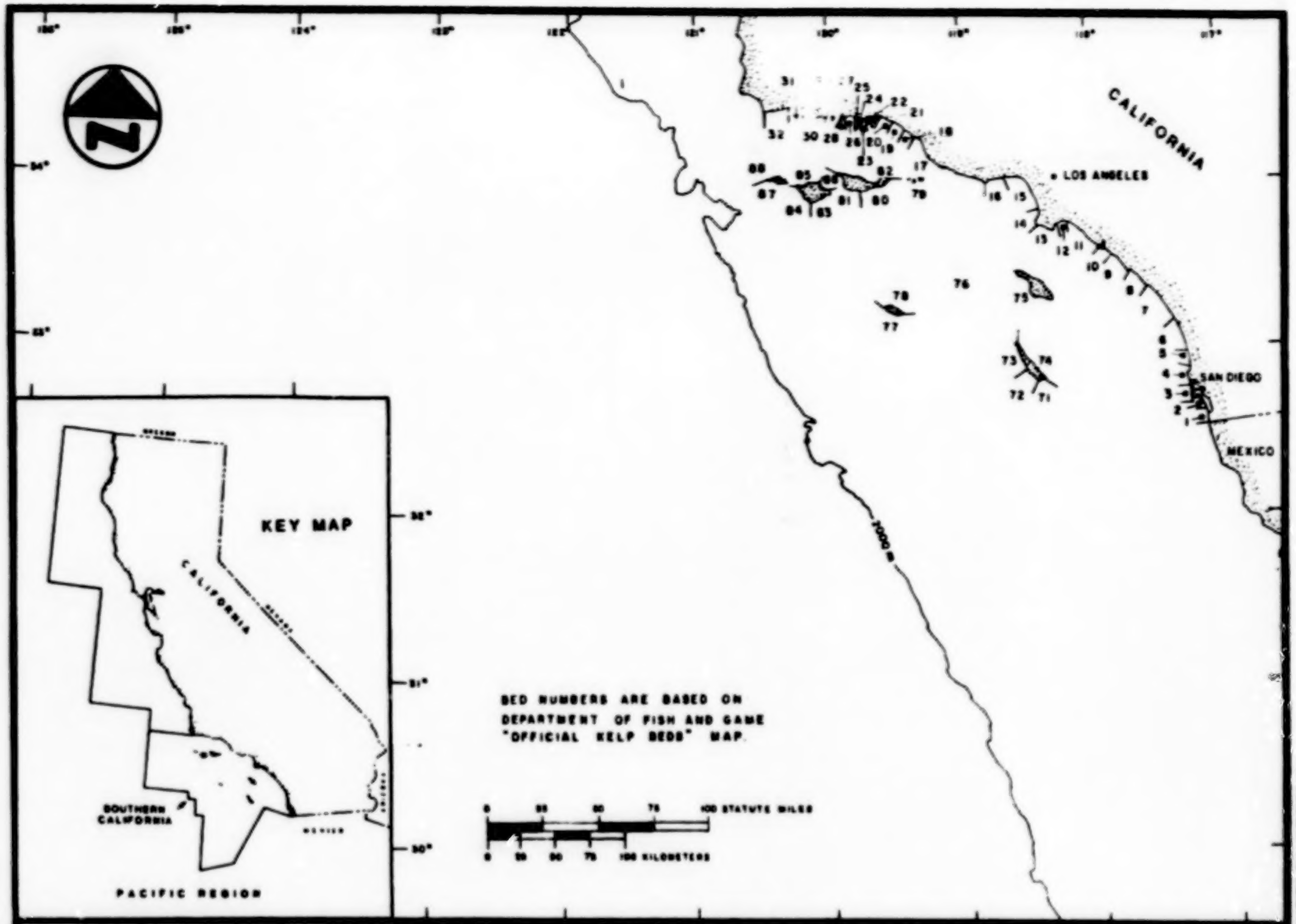

KELP BEDS SURVEYED DURING THE SOUTHERN CALIFORNIA BASELINE STUDY, YEAR II.

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ACCESS NUMBER: **29080.7**

STUDY TITLE: Southern California Bight Intertidal Baseline Survey, Year II.

REPORT TITLE: Intertidal Study of the Southern California Bight 1976/1977 (Second Year), Vol. III, Report 2.1 - High Molecular Weight Hydrocarbons in Sediments; Report 2.2 - Methodology Employed in HMW Hydrocarbon Analysis of Intertidal Sediments; Report 2.3 - Petroleum Hydrocarbon Analysis: Tissue Burdens of Intertidal and Subtidal Organisms collected during the 1976-1977 Program; Report 2.4 - HMWHC Analysis of Intertidal Flora and Fauna; Report 2.5 - GC/MS Studies.

CONTRACT NUMBER(S): BLM: CT6-40; MMS: 14-12-0001-29080.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1976; 1977.

COMPLETION DATE OF REPORT: November 1978.

COST(S): FY 1976: $2,631,229; FY 1977: $3,606,303; CUMULATIVE PROJECT COST: $6,237,532.

PROJECT MANAGER(S): E. Mishuck.

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KEY WORDS: Southern California; Southern California Bight; baseline; biology; hydrocarbons; sediment; gas chromatography; spectrometry; kelp; Macrocystis; mussel; Mytilus; sand crab; Emerita.

BACKGROUND: The initial Southern California Outer Continental Shelf (OCS) environmental study was conducted during 1975-1976. The project was continued and expanded the next year (1976-1977). This abstract is concerned with the principal investigators' reports on hydrocarbon studies carried out during the second year of the study.

OBJECTIVES: (1) To expand the baseline data base on hydrocarbons in sediments and biota for use in assessing possible future impacts; (2) To test the suspicioned paradigm that relatively fresh petroleum is deposited on the beach, slowly weathered, and ultimately transported to lower tide levels and the offshore region; and (3) To document methodology used during the study.

DESCRIPTION: Sediment samples were collected by pushing a stainless steel tube into the sediment to a depth of either 5 or 30 cm. Samples were frozen in precleaned glass jars. Samples were washed with distilled water, freeze dried, and soxhlet extracted with 3:7 toluene-methanol. Extracts were treated with granular copper to remove sulfur and saponified with a 1:1 mixture of 0.5 N potassium hydroxide (KOH) in methanol. Extracts were subjected to column, thin layer, and gas chromatography (GC) as well as gas chromatography-mass spectrometry (GC/MS).

Biological samples consisted mainly of giant kelp and sand crabs. Samples were collected in the field, frozen with dry ice, and stored at -20 C until analysis. Samples were thawed at room temperature, rinsed with distilled water and then with methanol, and diced. General analysis was similar to that for sediments.

The GC/MS analyses of the Year II intertidal biological samples were performed with the same basic instrumentation as in Year I; however, improvements were made by using wall-coated open tubular (WCOT) glass capillaries, installation of a more accurate scan control unit, and replacement of the separator between capillary outlet and mass spectrometer. In addition, the digestive tract of collected specimens were removed prior to tissue analysis during Year II.

SIGNIFICANT CONCLUSIONS: (1) Spiked aromatic compounds can be recovered from tissues by the extraction methods employed; (2) the selection of Mytilus californianus as an indicator species of petroleum contamination is supported for the Southern California Bight; (3) content of hydrocarbons in the sediments is low, but the dominant source of hydrocarbons in the intertidal sands appears to be petroleum; (4) identification of the source of petroleum hydrocarbons cannot be determined from the measured data because samples having different weathering histories show large distributional variations in the hexane and benzene fractions; (5) results obtained in this year's work prevent any firm conclusion to be drawn as to the factors controlling the distribution of hydrocarbons in beach sands.

STUDY RESULTS: Described in this report are the results of gravimetric and GC analysis of hexane and benzene fractions of 126 intertidal sediments collected from the Southern California OCS region, plus GC/MS analysis of 24 representative fractions. The results of the gravimetric analysis show that the range of total hydrocarbons is generally from 1 to 30 ug g^{-1} dry sediment for most locations. San Nicolas Island, San Miguel Island, San Clemente Island, and San Diego beaches generally have hydrocarbon contents of less than 10 ug g^{-1}, whereas Santa Catalina Island sediments have much higher concentrations (30 to 60 ug g^{-1}). Coal Oil Point Beach samples were up to 351 ug g^{-1}. Examples of chromatographic patterns are given for all the sites.

Representative samples from Coal Oil Point, Government Point, Corona del Mar, and San Nicolas Island were selected for GC/MS analysis. Results of these baseline analyses are shown in the text of the report.

A total of nine species was collected for analysis from 11 different sites during the period of September 1976 through April 1977. These species included: Eisenia arborea (macroalgae), Emerita analoga (common sand crab), Haliotis cracherodii (black abalone), Macrocystis pyrifera (giant kelp), Mytilus californianus (sea mussel), Nuttallina californica (chiton), Patiria miniata (bat star), Pisaster ochraceus (ochre sea star), and Tegula funebralis (black turban snail).

The body burdens for the various hydrocarbon fractions are given for samples collected during the summer and winter of 1975-1977 at the 11 sites. Of the organisms examined it appears that Mytilus californianus is the most promising as a choice for an indicator species.

Twenty-eight Macrocystis pyrifera (kelp) and eight Emerita analoga (sand crab) samples collected at six locations within the area were analyzed for their high molecular weight hydrocarbon (M.W. 198 through 478) composition. Sand crabs fell within two groups: (1) those from Corona del Mar and San Nicolas Island were characterized by low concentrations of biogenic hydrocarbons; (2) the ones from Coal Oil Point and Government Point contained relatively greater concentrations of compounds indicative of petroleum contamination.

Kelp blades contained lesser amounts of HMWHCs than did sand crabs. Four classes of kelp samples were observed: (1) kelp blades with very low saturate and unsaturate HMWHCs; (2) algal samples with slightly higher HMWHC levels than the first group, including biogenic n-alkanes and a reduced unresolved complex mixture (U.C.M.) of hydrocarbons; (3) kelp blades exhibiting biogenic plus petroleum hydrocarbon profiles, suggesting light petroleum contamination; (4) kelp samples with HMWHC profiles as in class two above plus hydrocarbons derived from encrusting bryozoans. All Government Point samples fell into the latter class.

STUDY PRODUCT(S): Kaplan, I. R. 1978. Intertidal Study of the Southern California Bight. Vol. III, Report 2.1 - High Molecular Weight Hydrocarbons in Sediments. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB300349/AS. Contract No. AA550-CT6-40. 198 pp.

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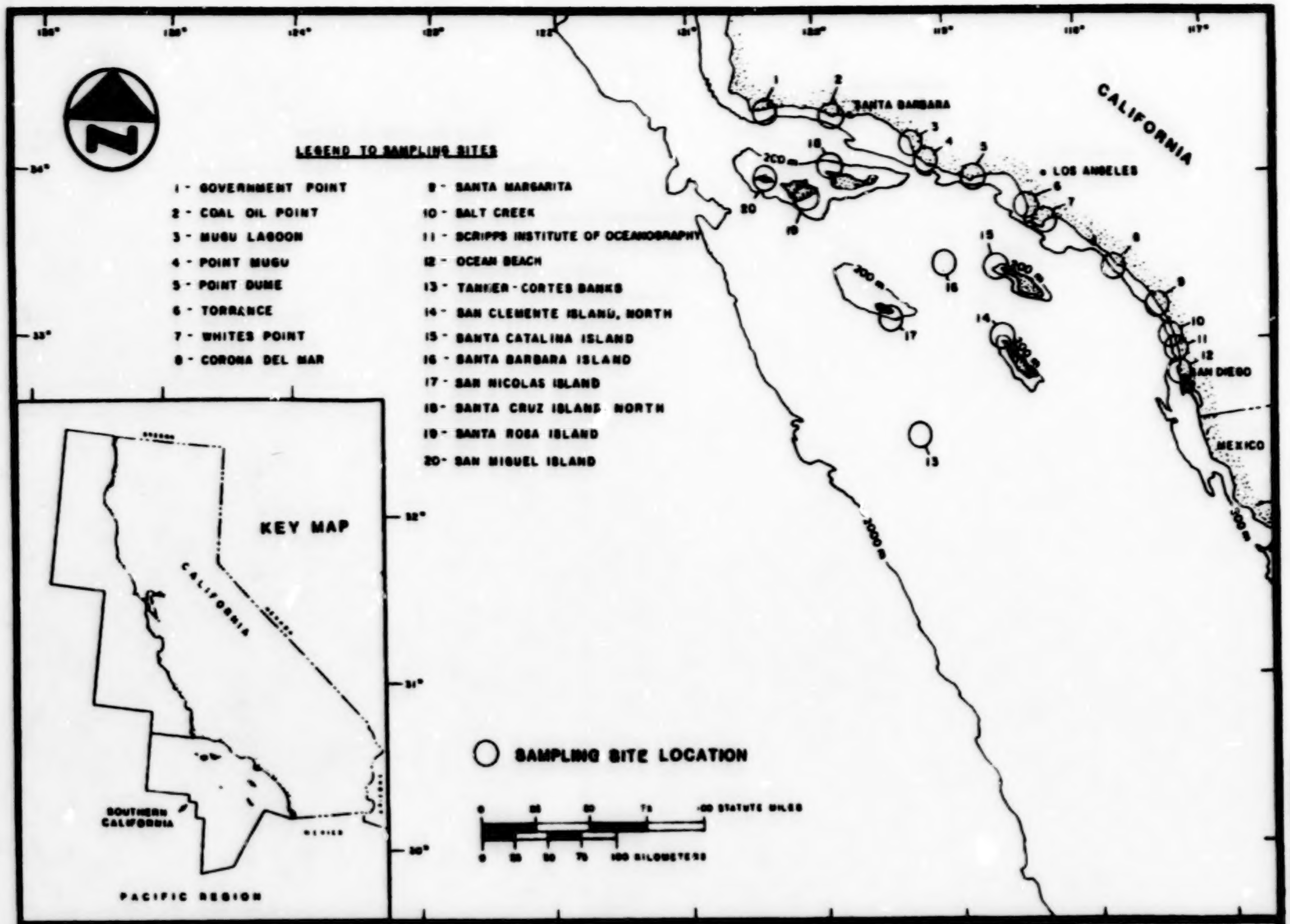
*P.I.'s affiliation may be different than that listed for Project Manager(s).



SAMPLING SITE LOCATIONS FOR THE SOUTHERN CALIFORNIA BASELINE STUDY, YEAR II.

ACCESS NUMBER:29080.7

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ACCESS NUMBER: **29080.8**

STUDY TITLE: Southern California Bight Intertidal Baseline Survey, Year II.

REPORT TITLE: Intertidal Study of the Southern California Bight, 1976/1977 (Second Year), Vol. III, Report 3.1 - Trace Metals in Sediments; Report 3.2 - The Concentration and Variability of Cd, Cr, Cu, Ni, Pb, and Zn in Intertidal/Subtidal Marine Organisms prior to Offshore Drilling in Southern California; Report 3.3.1 - Barium and Vanadium in Southern California Sediments Determined by Neutron Activation Analysis; Report 3.3.2 - Barium and Vanadium in Southern California Sediments Intertidal/Subtidal Fauna and Flora Determined by Neutron Activation Analysis; Report 4.1 - Sediment Texture and Organic Carbon Characterization; Report 4.2 - Determination of Microbial Biomass in Intertidal Sediments; Master Bibliography.

CONTRACT NUMBER(S): BLM: CT6-40; MMS: 12-14-0001-29080.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1976; 1977.

COMPLETION DATE OF REPORT: November 1978.

COST(S): FY 1976: $2,631,229; FY 1977: $3,606,303; CUMULATIVE PROJECT COST: $6,237,532.

PROJECT MANAGER(S): E. Mishuck.

AFFILIATION: Science Applications, Inc.

ADDRESS: P.O. Box 2351, 1200 Prospect Street, La Jolla, California 92037.

PRINCIPAL INVESTIGATOR(S)*: T. Chow, O. Holm-Hansen, V. Orphan.

KEY WORDS: Southern California; Southern California Bight; baseline; biology; intertidal; trace metals; sediment; microbiology; spectroscopy; mussel; Mytilus; sand crab; Emerita; kelp; Macrocystis; seasonality; grain size.

BACKGROUND: A comprehensive marine environmental survey of the Southern California coastal region was supported by the U.S. Department of the Interior from 1975 through 1977. A portion of this survey was devoted to trace metal studies of intertidal sediments and biota. Baseline information was gathered during 1975-1976 which allowed for sampling and analytical refinements during second year (1976 to 1977) studies.

OBJECTIVES: (1) To provide statistically valid baseline data on spatial and temporal variability in trace metal levels in intertidal sediments and biota; (2) To determine textural, carbonate, organic carbon, and microbial characteristics of intertidal sediments; and (3) To determine how and where petroleum development may affect the intertidal area.

DESCRIPTION: Intertidal sediments and biota from the Southern California mainland and island sites were analyzed for trace metals related to oil and gas activities. In 1975, Corona Del Mar, Coal Oil Point, Government Point, and San Nicolas Island were sampled seasonally. Sites added during winter (1976-1977) were Point Loma, San Clemente Island, San Miguel Island, Santa Cruz Island, and Santa Catalina Island. Four replicate samples were taken at each location (after removing the upper 5 cm of sediment) using a 2.5-cm diameter acrylic tube.

Samples were taken at lower, middle, and upper tide heights. Trace metals (cadmium, copper, lead, and nickel) were analyzed by flameless (graphite furnace) atomic absorption spectroscopy (AAS) after acid leaching (5N nitric acid). Chromium, iron, and zinc were determined by flame AAS. In conjunction with sediment trace metal studies, selected rocky and sandy intertidal and subtidal biota were analyzed for trace metal concentrations (cadmium, chromium, copper, lead, nickel, and zinc). Nine intertidal sites were sampled for California mussel Mytilus californianus, giant kelp, Macrocystis pyrifera, and black abalone Haliotis cracherodii. At sandy beaches, the sand crab Emerita analoga was collected. At four subtidal sites, two on Cortes Bank and two on Tanner Bank, the echinoderms Patiria miniata and Pisaster giganteus were collected for trace metal analysis. Specific organs or tissues were digested and then analyzed using either flame or flameless (graphite furnace) AAS depending on the metal. Aluminum, barium, and vanadium in sediments and biota were analyzed using more sensitive instrumental neutron activation analysis (INAA). Quality control measures were implemented on all instrumentation and laboratory procedures prior to actual data analyses.

During 1976-1977, 524 sediment samples were taken from 17 mainland and island sites and analyzed for their grain size, moisture content, and carbonate and organic carbon characteristics. Samples were frozen until analyses could be performed. Grain size was determined using settling tube, pipette, and particle analyzer. Total organic carbon was estimated using combustion techniques. Grain size frequency was divided into 1/4 phi intervals for computation of mean, sorting, skewness, and kurtosis. Preliminary tests of normality were performed prior to all statistical analyses (e.g., t-tests and regression). Sedimentary microfloral biomass was estimated from total sediment adenosine triphosphate (ATP) content.

SIGNIFICANT CONCLUSIONS: Analytical sensitivity necessary to discern small changes in leachable metals appears to be available. Variability in sediment metal concentrations were due to local mineralogy, pollution, and hydrodynamics at most intertidal sites. The variability in sediment metal concentrations increased with increasing sampling grid size. A sample of 20 to 30 individuals of Mytilus, Macrocystis, or Haliotis provided sufficient samples to detect acceptable mean differences in metal concentrations. Further collections of Emerita, Haliotis, and subtidal species should be discontinued due to their inavailability at most sites. Geographical, seasonal, or within-site studies should sample organisms from equal size classes to control metal size variations. Barium and aluminum exhibited low leachable fractions relative to iron and vanadium. There was good general agreement between intertidal trace metal levels reported for both study years. Sediment grain size and beach profile measurements are cost-effective environmental variables that may be used as control parameters during monitoring programs.

STUDY RESULTS: Each site exhibited a unique leachable trace metal distribution pattern; within site variations among locations were greater than between-site variations. Offshore islands were grouped into categories based on total and leachable metal concentrations. Varying concentrations on the islands are due to a number of causes, including mineralogy and pollution. Biotal samples were collected during 1975-1976 without replication, while in 1976-1977, fewer taxa with increased replication were sampled allowing spatial and temporal statistical comparisons. Biota from Corona Del Mar generally showed the highest trace metal concentrations. Copper values in Mytilus and Macrocystis were significantly lower in island samples than coastal samples. Significant seasonal differences were found for Mytilus while no seasonal differences were observed for Macrocystis. It was determined that for Mytilus, Macrocystis, and Haliotis that 20 to 30 samples are required for acceptable statistical resolution. The study indicated that the observed variations in aluminum, barium, and vanadium were due to sediment source and wave energy. All beaches had low leachable fractions of barium, aluminum, and vanadium. Barium and vanadium levels in macrobiota from benthic and intertidal areas were generally low. Total carbonate was generally higher at offshore sites.

Grain size parameters (mean, skewness, sorting, kurtosis) varied with intertidal position and core depth. At 5 to 20 cm depth, mean grain size was lowest, sorting was highest, skewness was most negative, and kurtosis was most positive. There was a relationship between grain size and beach profile slope. Coal Oil Point and Government Point were similar to each other in grain size and carbonate content, but distinct from other mainland beaches. Island beaches were not uniform in grain size characteristics but were unique in their high carbonate levels. Total organic carbon values could not be accurately associated with sediment carbonate or concentrations of organic matter. Total organic carbon was related to position in the intertidal zone, but not necessarily to grain size, with concentrations increasing from upper to lower tidal position. Seasonal variation in total organic carbon were indicated by statistically significant differences between winter and summer samples. Intertidal position, microepiflora, carbonate content, and presence of marine mammals all contributed to variations in total organic carbon. Intertidal ATP concentrations from four sandy beaches were lowest in high-tide samples with no apparent trend in lower and middle tidal samples.

STUDY PRODUCT(S): Science Applications, Inc. 1978. Intertidal Study of the California Bight—1976/1977. Vol. III, Principal Investigators' Reports, Sections 3.1, 3.2, 3.3, 4.1, 4.2, and Master Bibliography. A final report for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB300352/AS. Contract No. AA550-CT6-40. 220 pp. + app.

*P.I.'s affiliation may be different than that listed for Project Manager(s).

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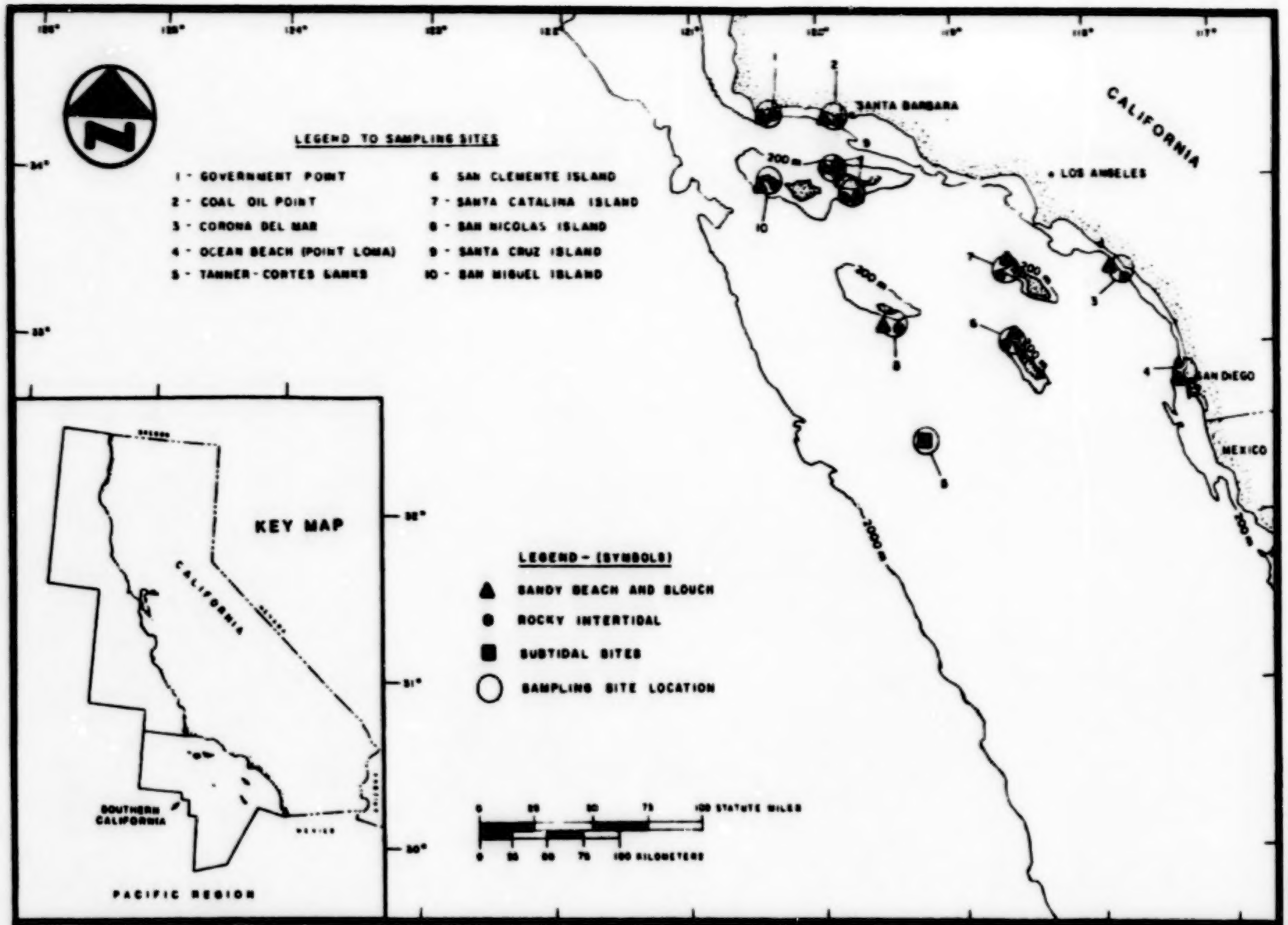

SAMPLING SITE LOCATIONS FOR THE SOUTHERN CALIFORNIA BASELINE STUDY, YEAR II.

ACCESS NUMBER:29080.8

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ACCESS NUMBER: 29080.8

ACCESS NUMBER: **29083**

STUDY TITLE: Southern California Bight Intertidal Baseline Study, Year III.

REPORT TITLE: Intertidal Study of the Southern California Bight: Summary and Synthesis of Principal Findings of the Third-Year Southern California Intertidal Baseline Study Program.

CONTRACT NUMBER(S): BLM: CT7-44; MMS: 14-12-0001-29083.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1975; 1976; 1977.

COMPLETION DATE OF REPORT: June 1979.

COST(S): FY 1975: $3,930,264; FY 1976: $2,631,229; FY 1977: $3,606,303; CUMULATIVE PROJECT COST: $10,167,796.

PROJECT MANAGER(S): W. Lippincott.

AFFILIATION: Science Applications, Inc.

ADDRESS: P.O. Box 2351, 1200 Prospect Street, La Jolla, California 92037.

PRINCIPAL INVESTIGATOR(S)*: A. Bainbridge, T. Chow, O. Holm-Hansen, G. Jones, B. Kallman, R. Kanter, I. Kaplan, M. Littler, P. Mankiewicz, J. Martin, A. Mearns, S. Murray, V. Orphan, W. Reed, R. Risebrough, D. Straughan.

KEY WORDS: Southern California; Southern California Bight; baseline; intertidal; biology; photographimetric technique; community; trace metals; spectrophotometry; hydrocarbons; sediment; grain size; microbiology; histopathology; macrophytes; aerial photography; recovery; seasonality; faunal zones; coastal zone.

BACKGROUND: The marine biota present in the Southern California Bight (SCB) represent a unique resource positioned at the northern reaches of the California biogeographic province. Intertidal studies on macrophytes and invertebrates of rocky shores within the SCB are relatively scarce. The quantitative data on intertidal and subtidal communities, particularly those of the offshore islands and banks, are limited. Investigations of the sandy beaches of the mainland coast have been investigated only recently, while beaches of the offshore islands have not been studied to any great extent. Chemical analyses, concentrating on trace metals and hydrocarbons, have become more prevalent within the last several years, but no comprehensive characterization of the SCB has ever been undertaken. This program, initiated in 1975, represents the first comprehensive, multi-year characterization of the biological, chemical, and physical attributes of the intertidal and subtidal communities of the SCB.

OBJECTIVES: (1) To extend and verify the two-year data base established for biological, sedimentological, and chemical variables during Years I (1975-1976) and II (1976-1977) of this program.

DESCRIPTION: For the rocky intertidal program, study methods were essentially unchanged from the previous two years with the exception of the addition (to increase geographic coverage) of 10 new sites, bringing the total number of sites to 22. Assessment of species composition and abundance was based on photographs of 0.15-m^2 and 1.0-m^2 quadrats arrayed systematically at 1- to 3-m intervals along several permanently marked transects. Disturbed sampling consisted of quantitative harvesting (wet, dry, ash-free biomass). Two special studies conducted in 1977-1978 were the island coastal aerial surveys (overflights with frequent landings to ground-truth assemblages) and the keystone species exclosure experiments (at two San Nicolas Island sites to exclude the anemone *Anthopleura elegantissima* or the abalone *Haliotis cracherodii*). Mussel beds were sampled at 19 sites, 8 more than in previous years; sampling consisted of photographs, physical measurements, and quintuplicate coring of mussels and associated biota. Samples of the California mussel (*Mytilus californianus*) and the giant kelp (*Macrocystis pyrifera*) were collected at four sites seasonally for trace metal analyses. *Mytilus* and *Haliotis* samples were also collected at five island and three mainland sites for hydrocarbon analysis, along with composite seawater and synoptic *Mytilus* samples at four offshore locations. For the sandy beach program, study methods were identical to previous years with the exception of the addition of two more beach sites. Coring and screening of beach sands was done in a stratified random grid of four columns of continuous 3 x 3-m quadrats. Microbial biomass samples were also secured concurrent with the sandy beach sampling effort. Sediment samples for hydrocarbon analysis were collected at six sites, with 80% of the 84 samples collected taken from San Nicolas Island and Coal Oil Point. Sediment samples for trace metal analysis were also collected at six sites with determinations made via atomic absorption spectrophotometry (AAS) or neutron activation analysis (NAA). A pilot histopathology program was also conducted at Coal Oil Point (Goleta Point) where 100 *Mytilus* during winter (1978) were analyzed for proliferative disorders, acute inflammation, ciroidosis, digestive gland metaplasia, and other pathologies.

SIGNIFICANT CONCLUSIONS: During the third year of this program, data were gathered on 22 rocky intertidal and 19 beach and slough locations along the mainland and offshore island coasts of Southern California. In addition, a pilot program designed to identify the physical abnormalities of a common intertidal organism, the California mussel, was completed. As was the case with Years I and II of this program, the composition and seasonal variation of the flora and fauna of the intertidal zones of Southern California was determined. In general, mainland areas exhibited lower numbers of individuals and lower body weights (total community body weight) than those sampled on the islands. Natural oil seeps and man's activities (harbors, ocean discharges) were implicated in higher hydrocarbon measurements within the California mussel. No discernible trends were evident for trace metals analyzed within mainland or island specimens. Physical variables such as sediment size, beach profile, and salinity were the primary factors determining the type and numbers of organisms encountered on sandy beaches and within sloughs of Southern California. Hydrocarbon and trace metal levels within sediments were variable and were generally elevated when collected in close proximity to a harbor, ocean discharge, or natural oil seep.

STUDY RESULTS: Generalized geographic patterns, particularly north to south, were noted for rocky intertidal and mussel bed sites and were attributed to both the hydrographic regime and physical variables present within the SCB. Insular communities exhibited greater biomass values than those on the mainland, attributed to the long-term detrimental anthropogenic effects of mainland activities and reduced natural disturbance from terrigenous sources on the islands; increased biomass was particularly evident for macrophytes. Areas subjected to recurrent disturbance were characterized by the presence of opportunistic species and a relatively immature community structure. Such disturbances did not materially alter the basic structure (i.e., zonation, major species assemblages) of the intertidal communities. Optimal recovery from mechanical removal of biota was seen in the lower intertidal, particularly among macrophytes. Full macrophyte cover was normally restored within 12 months, whereas none of the 11 sites monitored had fully recovered their preharvest invertebrate densities within 24 months. Mytilus samples from the mainland sites at Coal Oil Point, Government Point, and Corona del Mar showed the highest concentrations of unresolved hydrocarbons probably due to natural oil seeps and anthropogenic input; insular sites sampled were relatively clean with the exception of Santa Catalina Island. The seasonal contrasts in mussel hydrocarbon burden were less pronounced than the geographic patterns, although Santa Catalina Island specimens exhibited higher levels in summer than in winter, attributed to increased summer boating activity. For trace metals, the patterns for Mytilus and Macrocystis were mixed. Highest cadmium (Cd) and nickel (Ni) values were noted in mussels from San Nicolas Island (summer only), while highest copper (Cu) and lead (Pb) levels occurred in samples from Corona del Mar. Coal Oil Point mussels showed low Pb levels and low zinc (Zn) concentrations compared to other sites, but kelp from this area had high Ni, Cd, and chromium (Cr) (summer) levels. Cu concentrations in kelp revealed geographic trends comparable to those seen in mussels. Kelp samples from Corona del Mar had high Pb levels, also noted in mussel samples.

The sandy beach and slough communities were controlled primarily by physiographic and physical variables [e.g., grain size distribution, beach profile, salinity (primarily sloughs)]. Results noted that geographic patterns might exist, but they were marked by the dynamic, physically unstable character of beaches. Storm activity, quite extensive during Years I and II, precluded the establishment of any pattern of similarity at a given site. Storms also had the effect of dividing the intertidal sediments into distinct summer and winter populations, with mean grain size greater (coarser) in winter. The general trends of coarser sediments in the mid-tide zone (as compared with the lower), low levels of total organic carbon (TOC), and greater concentrations of carbonate in island beaches were confirmed in Year III. TOC can be influenced by macrobiota, while carbonate content was related to the presence or absence of fluvial influence. Intertidal sediments exhibited a wide range of hydrocarbon concentrations, with the lowest values at San Nicolas Island (from terrestrial plants and marine plankton) and the highest values at Coal Oil Point and Catalina Harbor. Intensive collections of sediment samples at Coal Oil point indicated that hydrocarbons were significantly more concentrated and variable than at mid-tide levels. Seasonal hydrocarbon ranges were also greatest at Coal Oil Point, consistent with previous findings. Trace metals in beach sands generally reflected proximity to the sources from which they were derived. Elevated Pb and Cd levels at Corona del Mar were attributed to fallout of aerosols and nearby sewage outfalls.

STUDY PRODUCT(S): Lippincott, W. H. (ed.). 1979. Intertidal Study of the Southern California Bight: Summary and Synthesis of Principal Findings of the Third-Year Southern California Intertidal Baseline Study Program. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB80-143704/AS. Contract No. AA550-CT7-44.

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*P.I.'s affiliation may be different than that listed for Project Manager(s).

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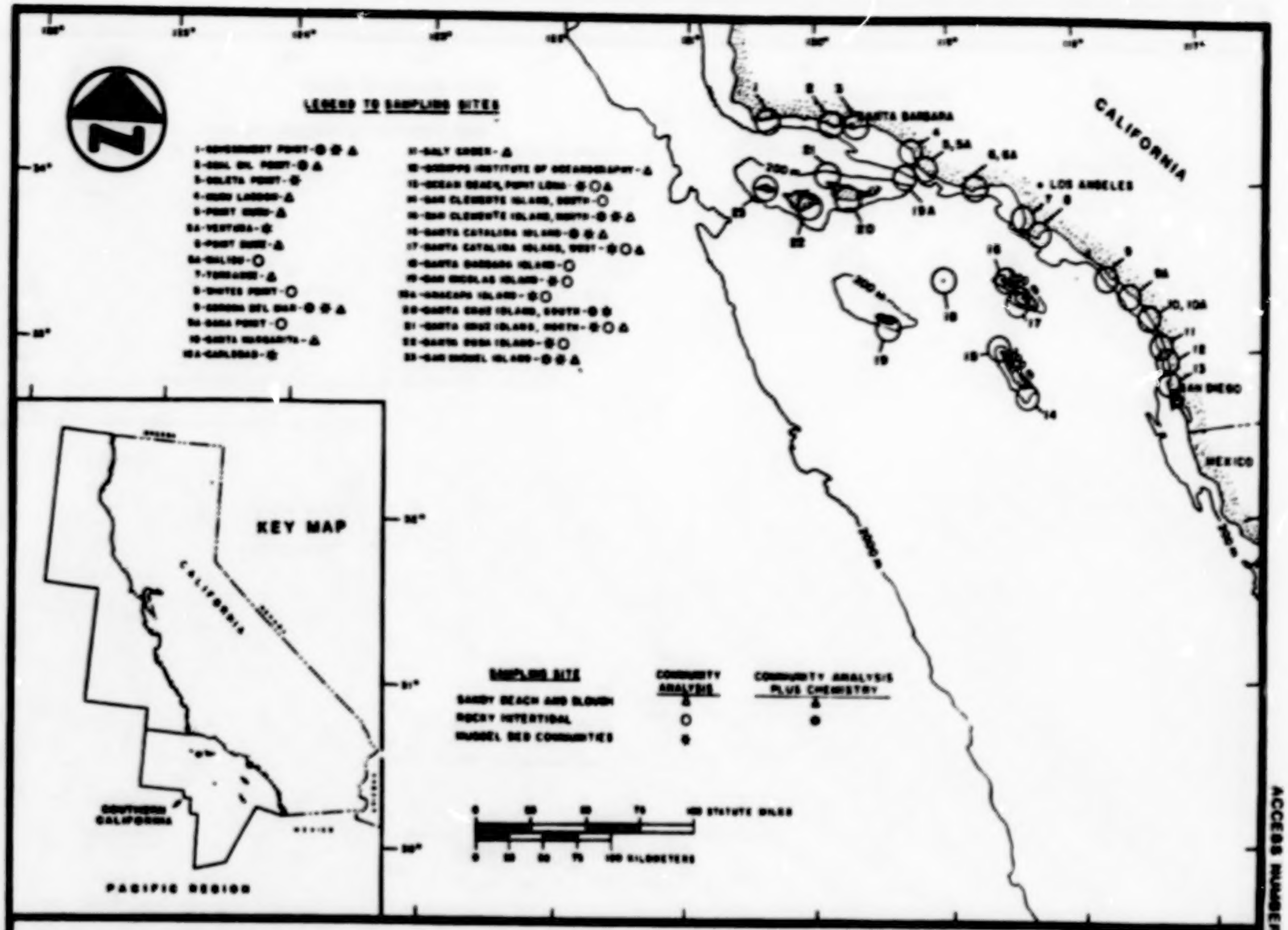

SAMPLING SITE LOCATIONS AND ANALYSES CONDUCTED DURING THE SOUTHERN CALIFORNIA INTERTIDAL BASELINE STUDY, YEAR III.

82

ACCESS NUMBER: **29083.2**

STUDY TITLE: Southern California Bight Intertidal Baseline Survey, Year III.

REPORT TITLE: Intertidal Study of the Southern California Bight, 1977/1978 (Third Year), Vol. II, Report 1.0 - The Distribution, Abundance, and Community Structure of Rocky Intertidal and Tidepool Biotas in the Southern California Bight; Report 2.0 - Experimental Studies of the Recovery of Populations of Rocky Intertidal Micro-Organisms Following Mechanical Disturbance; Report 3.0 - Catastrophic Surveys of Rocky Intertidal Communities Following Natural Disturbances; Report 4.0 - The Effects of *Anthopleura elegantissima* and *Haliotis cracherodii* on Rocky Intertidal Community Structure; Report 5.0 - Rocky Intertidal Island Survey; Report 6.0 - Assessments of Overall, Intersite, and Site-Specific Distribution and Abundance Patterns of Rocky Intertidal Organisms in the Southern California Bight; Report 7.0 - Mussel Community Studies.

CONTRACT NUMBER(S): BLM: CT7-44; MMS: 14-12-0001-29083.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1976.

COMPLETION DATE OF REPORT: May 1979.

COST(S): FY 1976: $2,137,858; CUMULATIVE PROJECT COST: $2,137,858.

PROJECT MANAGER(S): W. Lippincott.

AFFILIATION: Science Applications, Inc.

ADDRESS: P.O. Box 2351, 1200 Prospect Street, La Jolla, California 92037.

PRINCIPAL INVESTIGATOR(S)*: R. Kanter, M. Littler.

KEY WORDS: Southern California; Southern California Bight; baseline; intertidal; distribution; recovery; community; macrophytes; epifauna; biology; photographimetric technique; macrophytes; sediment.

BACKGROUND: The rocky intertidal communities of the Southern California shoreline are subject to stress from recreation-oriented human use of these areas. Because of this stress, the rocky communities may be particularly sensitive to additional forms of disturbance. The cumulative effects of environmental degradation and a general lack of baseline data have in the past posed problems when attempting to assess the immediate effects of specific pollutants on the organisms within these habitats. The present studies were initiated by the U.S. Department of the Interior to provide the information needed to determine the potential impacts from offshore oil and gas development on the intertidal habitats.

OBJECTIVES: (1) To establish quantitatively reliable and reproducible baseline data on the distribution and abundance of rocky intertidal organisms; and (2) To relate distribution and abundance to biological and environmental features of the environment.

DESCRIPTION: Intertidal communities were sampled at 22 representative sites (7 mainland and 15 island sites) over a three-year period. Macroinvertebrate and macrophyte species were assessed in terms of tidal location, cover, frequency, density, wet weight, dry weight, ash-free dry weight, species diversity, evenness, richness, and cluster analysis. Specialized studies were undertaken to measure the response of the rocky intertidal communities to natural catastrophic events, to assess the role of possible key species, and to determine recovery rates of various communities following artifical disturbance.

SIGNIFICANT CONCLUSIONS: Rocky intertidal and mussel beds have a high diversity of algal and invertebrate species. Community distribution patterns appear to be highly influenced by characteristic water masses and circulation patterns. Intertidal sites subjected to natural and man-induced stress will undergo various levels of change depending on the type of perturbation. Macrophytes appear to recover from these perturbation more quickly than invertebrates.

STUDY RESULTS: A total of 539 species, including 224 macrophytes and 315 macroinvertebrates, were identified during the study. The dominant macrophytes and macroinvertebrates, respectively, in terms of various parameters were as follows: numbers of species - Rhodophyta and gastropods; biomass - Phaeophyta (particularly Egregia menziesii) and the mussel Mytilus californianus; cover - blue-green algae and Phragmatopoma californica; frequency of occurrence - blue-green algae and the barnacle Chthamalus fissus dalli; density - Chthamalus fissus dalli; dry weight - Egregia menziesii (119 g m^{-2}) and Mytilus californianus (51 g m^{-2}). When all parameters were summed and averaged, island sites had higher values than mainland sites. Mainland sites near population centers had reduced cover and biomass in comparison to sites near less heavily populated mainland areas. Macrophyte crops were higher in the Southern Channel Islands than Northern Channel Islands sites. Mainland standing crops were lower than island sites. This pattern at mainland sites may be due to environmental stress. In most instances, sites classified by cluster analysis tended to show groupings related to water temperature at the site. Cold water, warm water, and intermediate temperature groupings were identified. In a cluster analysis based on percent cover statistics, two major groups were identified that were related to the influence of sand.

At artifically disturbed sites, macrophytes recovered more quickly than the macroinvertebrates and southern sites recovered more rapidly than northern sites. Mean densities at the end of 24 months were 76% of preharvest densities due largely to the slow recovery of the invertebrates. Cover was most rapidly established at sites subject to the greatest natural disturbance although cold-water sites reestablished preharvest communities more slowly. Larger algae inhabiting the upper shoreline, mussels, clams, and chitons were the slowest to recover and probably the most susceptible to disturbance. Highly resilient species included the articulated coralline algae, several species of opportunistic algae, and the annelid Phragmatopoma californica.

Surf actively removed the larger, delicate, opportunistic thalli that reoccupied the substrate at a site previously exposed to heavy surf activity. However, there was one apparent recovery of some species due to heavy recruitment by invertebrates. At a site subjected to desiccation, relatively high temperatures, moderate rainfall, and high surf, there were no major differences in percent cover and species abundance in tide pool and non-pool biota. Differences observed in frequency and density measurements could not be explained. Mortality in macrophyte thalli was more pronounced in samples exposed to air. Slight mortalities were observed for dominant macroinvertebrate species in pool and non-pool samples. Heavy sediment loading at an intertidal site led to complex population changes although the basic community structure was not changed. Macrophyte die-offs were less significant than those for the invertebrates. Removal of the dominant macroinvertebrates, the anemone Anthopleura elegantissima and the abalone Haliotis cracherodii, at two sites led to rapid colonization of free space by opportunistic algae, decreased algal abundances due to algal bleaching, and increases in attached invertebrate species and mobile gastropods.

A total of 610 faunal species and 141 algal species were found associated with mussel (Mytilus californianus) beds from 20 sampled sites. Island sites were more diverse than mainland sites. Community assemblages showed five distinct patterns: (1) a north-south distribution based on similarity of the communities; (2) a separation of island and mainland communities based on dissimilarities in species composition; (3) differences in communities on opposite sides of islands; (4) clusters of species whose highest abundances characterized selected localities; and (5) ubiquitous species groups. Distribution patterns may correspond to currents and water masses which transport planktonic larvae to a site. High species diversity was associated with the pore base of shell and rock debris, mussel bed thickness, and sediment grain size. Tar, rock, and shell debris trapped within the mussel beds lowered species diversity.

STUDY PRODUCT(S): Science Applications, Inc. 1979. Intertidal Study of the Southern California Bight, 1977/1978 (Third Year) Final Report. Volume II. A final report for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. Vol. II (Report 1.0, Sections 1-7) - NTIS No. PB80-143712/AS; Vol. II (Report 1.0, Sections 8-15) - NTIS No. PB80-143720/AS; Vol. II (Report 1.0, Sections 16-22) - NTIS No. PB80-143738/AS; Vol. II (Reports 2.0 to 7.0) - NTIS No. PB80-143746/AS. Contract No. AA550-CT7-44.

A series of island coastal survey maps were also developed from this study effort.

*P.I.'s affiliation may be different than that listed for Project Manager(s).

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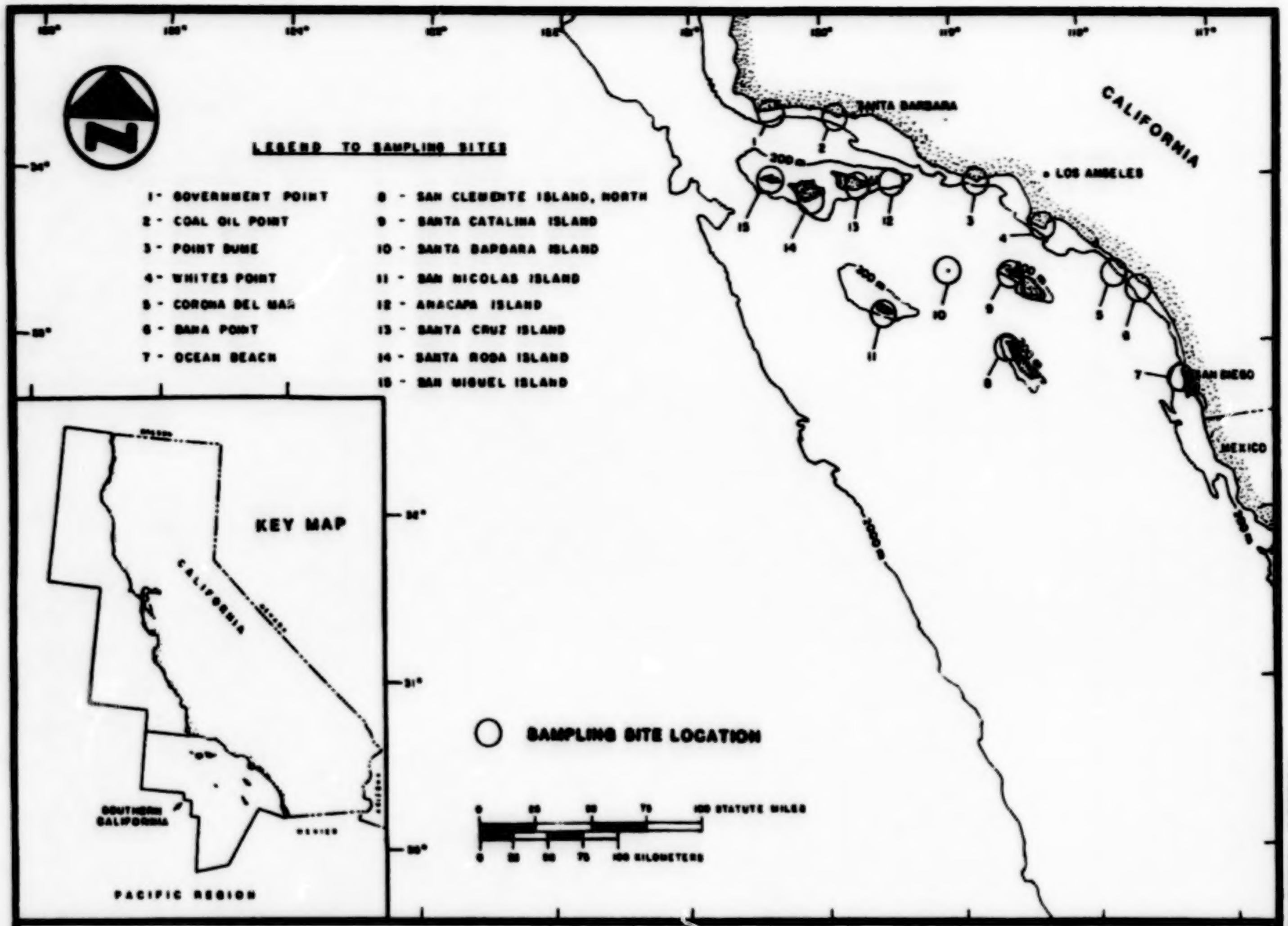

SAMPLING SITE LOCATIONS FOR THE SOUTHERN CALIFORNIA STUDY, YEAR III.

ACCESS NUMBER:29083.2

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ACCESS NUMBER: **29083.3**

STUDY TITLE: Southern California Bight Intertidal Baseline Survey, Year III.

REPORT TITLE: Intertidal Study of the Southern California Bight, 1977/1978 (Third Year), Vol. II, Report 8.0 - Sandy Beach and Slough Community Analysis; Report 9.0 - Sandy Beach Meiofauna at Coal Oil Point.

CONTRACT NUMBER(S): BLM: CT7-44; MMS: 14-12-0001-29083.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1976.

COMPLETION DATE OF REPORT: 1979.

COST(S): FY 1976: $2,137,858; CUMULATIVE PROJECT COST: $2,137,858.

PROJECT MANAGER(S): W. Lippincott.

AFFILIATION: Science Applications, Inc.

ADDRESS: P.O. Box 2351, 1200 Prospect Street, La Jolla, California 92037.

PRINCIPAL INVESTIGATOR(S)*: D. Straughan.

KEY WORDS: Southern California; Southern California Bight; baseline; intertidal; biology; sandy beach; slough; oil spill; crab; Emerita; abiotic variables.

BACKGROUND: The U.S. Department of the Interior is required to conduct studies in the marine environment prior to leasing land for oil and gas operations. This report presents the third-year research results of such a study on sandy beaches and in sloughs of the Southern California borderland. The results were meant for use in siting shore-based facilities not only in relation to Outer Continental Shelf (OCS) development but in relation to development of offshore and onshore State lands.

OBJECTIVES: (1) To record natural and man-made variables operating in sandy beach and slough environments; (2) To relate the variables to biological data; and (3) To predict possible impacts of oil spills.

DESCRIPTION: The Year III study occurred from July 1977 through June 1978. Twenty sites were surveyed to account for the variables affecting macrofauna species abundance and distribution and to cover as many habitats as possible in the area from Point Conception to the Mexico border including the offshore islands. Data were collected on a biannual basis at most sites, and quarterly surveys were conducted at sites of specific interest. The stratified quadrat method, which involved collection of cores in a continuous grid pattern from high to low tide marks, was used at all sites except two where a discontinuous grid was used. Supplementary box samples were collected at two sites. For the meiofaunal portion of the study, 270 samples were collected from Coal Oil Point on 25 September 1976. A 1.5-mm mesh size was used. Abiotic data recorded included: air, water, and substrate surface and subsurface temperatures; ocean and interstitial salinity; tar; total organic carbon, total inorganic carbon, and calcium carbonate; sediment grain size; Ohaus moisture and organic contents of sediments; and beach profiles. Biotic data recorded included identification, abundance, and biomass of species. Records also included information on birds, marine mammals, and humans in the area. Methods of data analyses were similar to those used in previous years, but the third-year effort included use of weighted discriminant analysis. Coefficients of separate determination of 20 and above were considered important.

SIGNIFICANT CONCLUSIONS: Salinity, beach length, grain size, moisture content, and tar were dominant abiotic factors affecting sandy beach and slough biota. Abiotic and biotic variabilities were greater at northern sites that at southern sites. More species and specimens occurred on long, gently sloping, fine-grained beaches than on short, steep, coarse-grained beaches. Crustaceans were found at most sites under most conditions when sand was present. The sand crab Emerita analoga was the most widely distributed species. Oil spill impacts will depend on the retention time of petroleum in a habitat. The data supported previous observations and predictions of a long retention time of petroleum on sheltered beaches and sloughs. Most open coast beaches have a short retention time of petroleum because of a relatively predictable annual cycle of erosion and accretion that uncovers and removes buried tar the following year. Other factors that will influence the severity of oil spill impacts include the oil composition, dosage, and physical state.

STUDY RESULTS: Two categories of beaches were defined for the Southern California Bight: one type maintains site integrity (e.g., Twin Harbors and Scripps), while the other is extremely variable (e.g., Point Mugu and Coal Oil Point). Most beaches lose sand in winter and gain sand in summer, the extent varying with the relative exposure of the site. There was a reduction of intertidal biota at all sites surveyed after winter storms; further studies are needed to determine the normal recovery period after heavy winter storms. Sandy beach biota responded to abiotic parameters in a predictable manner. The greater the environmental stability, the more important the biotic interactions in a community. Long, gently sloping, fine-grained beaches with no periodically exposed beach rock have the most organisms, most species, and representatives of all species groups. Crustaceans were generally the only organisms on short, steeply sloping, coarse-grained beaches. As the beach became more gently sloping and as grain size became finer, polychaetes were found as well. Molluscs were found in lower intertidal areas with increased beach length, further sediment fineness, and more stability. Echinoderms and fishes became part of the biota as sediments became even finer and the conditions even more stable and sheltered. The highest number of meiofaunal species, number of specimens, diversity index, and richness were recorded in the upper intertidal level, while the highest equitability value was recorded in the middle intertidal level. Approximately 45% of the species were in the upper 5 cm of sand at all three intertidal levels. Nematodes were the most abundant meiofaunal organisms. Harpacticoid copepods, which often are abundant in sandy beaches, were not collected. While sediment stability was the dominant abiotic factor on sandy beaches, salinity regime stability was most important in sloughs. Slough communities were most stable, diverse, and abundant in areas with the least salinity variability.

STUDY PRODUCT(S): Straughan, D. 1979. Intertidal Study of the Southern California Bight. Vol. II. Report 8.0 - Sandy Beach and Slough Community Analysis. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB80-143746/AS. Contract No. AA550-CT7-44. 151 pp.

ACCESS NUMBER: **29083.3**

Straughan, D. 1979. Intertidal Study of the Southern California Bight. Vol. II, Report 9.0 - Sandy Beach Meiofauna at Coal Oil Point. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB80-143746/AS. 23 pp.

*P.I.'s affiliation may be different than that listed for Project Manager(s).

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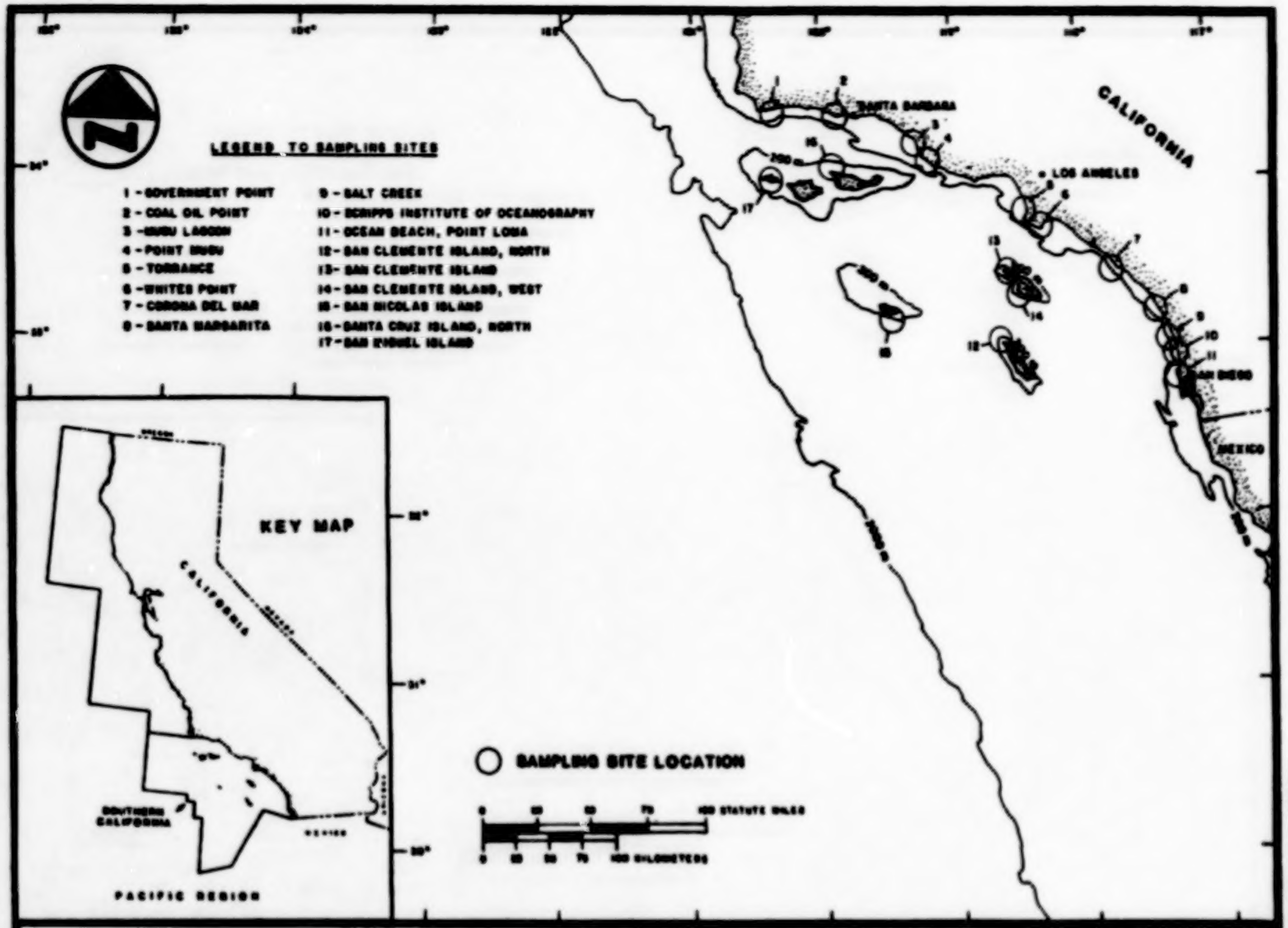

SAMPLING SITE LOCATIONS FOR THE SOUTHERN CALIFORNIA BASELINE STUDY, YEAR III.

ACCESS NUMBER: **29083.4**

STUDY TITLE: Southern California Bight Intertidal Baseline Survey, Year III.

REPORT TITLE: Intertidal Study of the Southern California Bight, 1977/1978 (Third Year), Vol. II, Report 10.0 - Analysis and Characterization of High-Molecular-Weight Hydrocarbons in Intertidal Sands from the Southern California Borderland; Report 11.1 - Trace Metal Concentrations in the Southern California Bight Intertidal Sediments; Report 11.2 - Barium and Vanadium in Intertidal Sediments Determined by Neutron Activation Analysis; Report 12.0 - Sediment Texture and Indigenous Carbon Analysis.

CONTRACT NUMBER(S): BLM: CT7-44; MMS: 14-12-0001-29083.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1976.

COMPLETION DATE OF REPORT: May 1979.

COST(S): FY 1976: $2,137,858; CUMULATIVE PROJECT COST: $2,137,858.

PROJECT MANAGER(S): W. Lippincott.

AFFILIATION: Science Applications, Inc.

ADDRESS: P.O. Box 2351, 1200 Prospect Street, La Jolla, California 92037.

PRINCIPAL INVESTIGATOR(S)*: S. Brenner, T. Chow, J. Earl, R. Jordan, I. Kaplan, P. Mankiewicz, J. Nemmers, V. Orphan, J. Payne, W. Reed, E. Ruth, I. Venkatesan, T. Walsh.

KEY WORDS: Southern California; Southern California Bight; baseline; intertidal; sediment; hydrocarbons; trace metals; grain size; sandy beach; gas chromatography; spectroscopy; seasonality.

BACKGROUND: The U.S. Department of the Interior supported a three-year multidisciplinary intertidal baseline study in the Southern California Bight. These reports include third year results of trace metal, hydrocarbon, and textural studies of sediments from mainland and island beaches located in the Southern California Bight. This information will allow before, during, and after management decisions to be made regarding oil and gas exploration in the area.

OBJECTIVES: (1) To determine sediment hydrocarbon concentrations from intertidal areas; (2) To collect statistically reliable background data on leachable and total trace metal concentrations from intertidal sediments; and (3) To determine beach profile and sediment textural characteristics for mainland and island beaches.

DESCRIPTION: Intertidal sediments collected during 1977 to 1978 were analyzed for high molecular weight hydrocarbons, trace metals, and textural properties. Two beaches, San Nicolas Island and Coal Oil Point, were intensively sampled for their hydrocarbon content. Four additional beaches were sampled in summer, by taking surficial samples from a sampling grid at each site. Samples, collected with stainless steel or anodized aluminum core tubes, were frozen until laboratory analyses. Thawed samples were extracted, separated gravimetrically, then subjected to high resolution gas chromatography and gas chromatography-mass spectroscopy (GC/MS). Trace metal determinations were made on intertidal sediments collected from six Southern California beaches: Government Point, Coal Oil Point, Corona del Mar, San Diego, Santa Catalina Island, Twin Harbors, and San Nicolas Island during 1977 to 1978. Leachable and total dissolutions of cadmium, chromium, copper, iron, nickel, lead, and zinc were analyzed by atomic absorption spectrophotometry. Barium and vanadium were analyzed separately using instrumental neutron activation analysis. Sediment texture, beach profiles, and total organic carbon were measured at 19 beaches and sloughs along the Southern California Bight and on the Channel Islands, both in Summer 1977 and Winter 1978. Sediment samples were collected from a random quadrat grid. Sand fraction grain-size distribution was determined using an automatic particle analyzer. Mean, sorting, skewness, kurtosis, and various percentiles were reported from a grain-size frequency distribution (1/4 phi intervals).

SIGNIFICANT CONCLUSIONS: Intertidal sediments from mainland beaches displayed a prominence of petroleum-derived hydrocarbons while offshore island sites contained mostly biogenic hydrocarbons. Concentrations of hydrocarbons increased significantly with sampling depth and in samples from low-tide levels. The chlorinated hydrocarbon pp'DDE was present in most samples and highest amounts were found in beaches near Los Angeles. Other contaminants were also higher in the southern portion of the study area, suggesting greater contributions from urban runoff or air pollution fallout. It was determined that the leachable fraction of any beach sand metal was related to mineralogy and to a lesser extent carbon content. The trace metal data assembled for the Southern California Bight possess the sufficient analytical sensitivity required to detect subtle changes in leachable metal contents caused by future contamination events. A severe winter storm season (1978) greatly affected beach profiles and grain size distributions. Rains associated with these storms influenced the calcite content of beach sediments.

STUDY RESULTS: Hydrocarbon levels of most surficial samples were below 5 ug g^{-1} with considerably higher values occurring at the Coal Oil Point and Catalina Harbor sites. Lowest hydrocarbon levels (<1 ug g^{-1}) were detected at San Nicolas Island. Petroleum hydrocarbons were the dominant fractions at most sites with the exception of San Nicolas Island which contained biogenic compounds. Biogenic sources were marine planktonic olefins and terrestrial plant-wax parrafins. Over 90% of the mainland beach (Coal Oil Point and Catalina Harbor) sediment hydrocarbon concentrations, analyzed by GC/MS, were unresolved complex mixtures associated with weathered petroleum and pyroletic sources. Samples from low tide areas exhibited the most variability in hydrocarbon concentrations compared to other tidal levels. Consistent trends in the resolved/unresolved complex mixture ratios (varies with source and weathering history) and resolved benzene/unresolved hexane (higher in samples with high total concentrations) were observed.

Leachable trace metal levels were not significantly different from second year estimates from samples collected at Coal Oil Point, Corona del Mar, and San Nicolas Island. Proximity to industrial and urban input, prevailing circulation pattern, geochemistry, tidal height, and season all contributed to variations in trace metal concentrations. Generally, trace metal levels have not changed appreciably over the three-year study period despite significant physical changes at the sampling sites.

Seventy-two percent of the transects sampled at middle and lower tidal levels indicated that the middle level contained coarser mean grain-size than the lower tide samples. Grain size coarseness increased with depth in the sediments. Variation in grain size parameters were more pronounced during this study (Year III) than the previous two years. Beaches tend to become coarser, more poorly sorted, and more positively skewed in winter relative to summer. Beach face profiles vary with season (storm wave energy and frequency) and location. Relationships between median grain-size and slope were obscured by the extreme energy inputs (storms) during winter months. Total organic carbon ranges from 0.02 to 0.71%, but most samples are below 0.15%. Seasonal differences were found at four beaches only, and tidal height did not affect total organic carbon levels. Calcite content was about 1.5% lower, on average, in winter than summer. Island beaches displayed mean calcite contents at 18.4% opposed to 1.8% for mainland beaches. Some island sites exhibited significant changes in calcite content with season.

STUDY PRODUCT(S): Mankiewicz, P., R. Jordan, J. Nemmers, J. R. Payne, I. R. Kaplan, I. Venkatesan, E. Ruth, and S. Brenner. 1979. Intertidal Study of the Southern California Bight. Vol. II, Report 10.0 - Analysis and Characterization of High Molecular Weight Hydrocarbons in Intertidal Sands from the Southern California Borderland. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB80-143753/AS. Contract No. AA550-CT7-44. 31 pp.

Chow, T. J. and J. L. Earl. 1979. Intertidal Study of the Southern California Bight. Vol. II, Report 11.0 - Trace Metals in Sediments. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB80-143753/AS. Contract No. AA550-CT7-44. 56 pp.

Walsh, T. J. and W. E. Reed. 1979. Intertidal Study of the Southern California Bight. Vol. II, Report 12.0 - Sediment Texture and Indigenous Carbon Analysis. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB80-143753/AS. Contract No. AA550-CT7-44. 38 pp.

*P.I.'s affiliation may be different than that listed for Project Manager(s).

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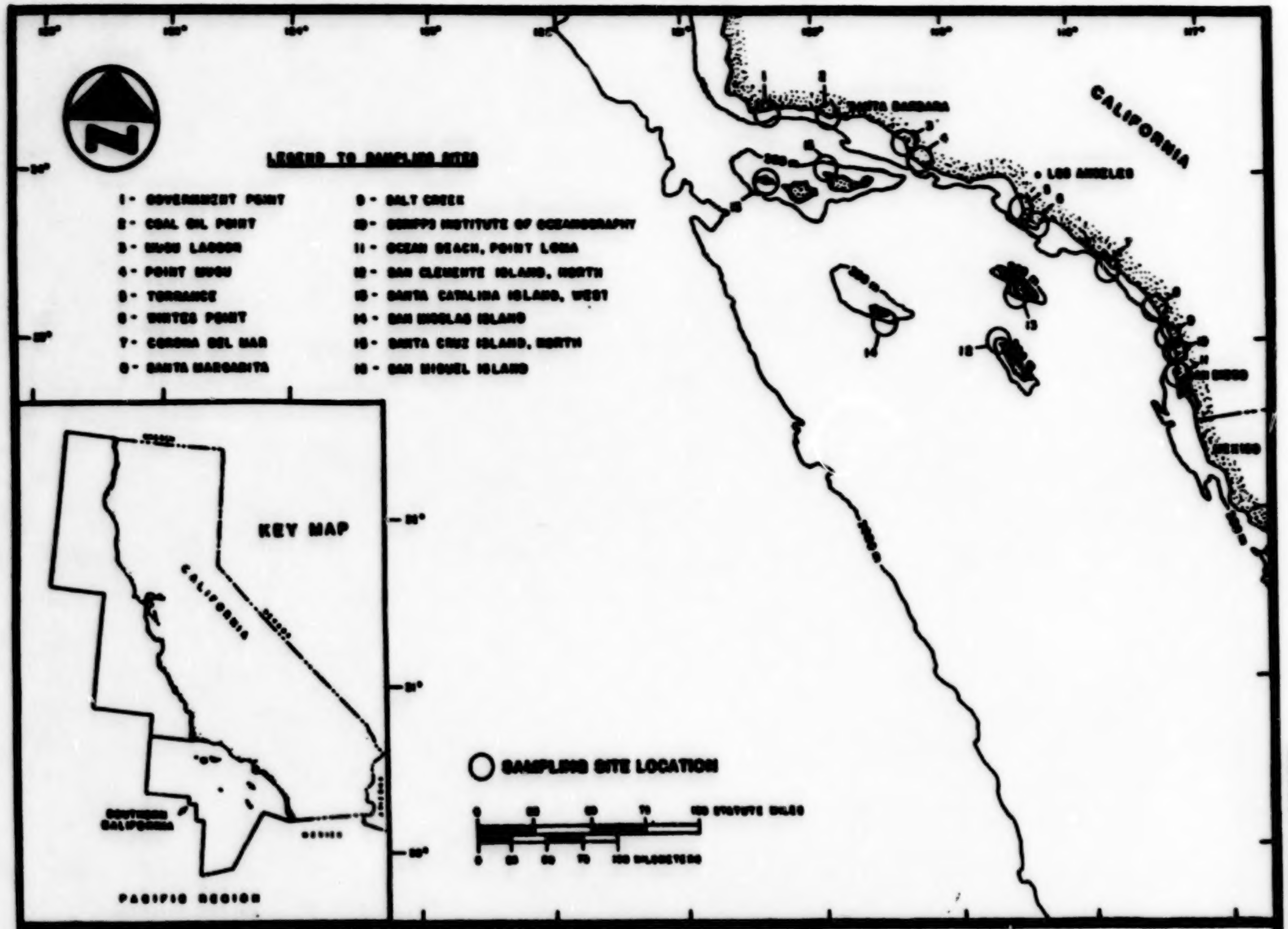

SAMPLING SITE LOCATIONS FOR THE SOUTHERN CALIFORNIA BASELINE STUDY, YEAR III.

ACCESS NUMBER:29083.4

ACCESS NUMBER: 29083.4

ACCESS NUMBER: **29083.5**

STUDY TITLE: Southern California Bight Intertidal Baseline Survey, Year III.

REPORT TITLE: Intertidal Study of the Southern California Bight, 1977/1978 (Third Year), Vol. II, Report 13.0 - Microbial Biomass (ATP), in Sediments; Report 14.0 - Hydrocarbons in Intertidal Organisms of of the Southern California Bight; Report 15.0 - the Partitioning of Petroleum and Related Compounds Between the Mussel Mytilus californianus and Seawater in the Southern California Bight; Report 16.1 - The Concentration and Variability of Cd, Cr, Cu, Ni, Pb, and Zn in Intertidal Samples of Mytilus californianus and Macrocystis sp.; Report 16.2 - Barium and Vanadium in the Marine Intertidal Organisms Mytilus californianus and Macrocystis sp. from the Southern California Bight Area.

CONTRACT NUMBER(S): BLM: CT7-44; MMS: 14-12-0001-29083.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1976.

COMPLETION DATE OF REPORT: May 1979.

COST(S): FY 1976: $2,137,858; CUMULATIVE PROJECT COST: $2,137,858.

PROJECT MANAGER(S): W. Lippincott.

AFFILIATION: Science Applications, Inc.

ADDRESS: P.O. Box 2351, 1200 Prospect Street, La Jolla, California 92037.

PRINCIPAL INVESTIGATOR(S)*: B. deLappe, D. deLappe, M. Gordon, O. Holm-Hansen, J. Lane, E. Letterman, J. Martin, J. Payne, R. Risebrough, J. Shropshire, W. Sistek.

KEY WORDS: Southern California; Southern California Bight; baseline; microbiology; biology; mussel; Mytilus; trace metals; hydrocarbons; seasonality.

BACKGROUND: The U.S. Department of the Interior supported comprehensive baseline studies of the Southern California intertidal region from 1975 to 1978. To suppport management decisions, accurate data on background levels of contaminants (trace metals and hydrocarbons) related to oil and gas activities were needed for intertidal biota, water column, and sediments.

OBJECTIVES: (1) To determine microbial biomass in intertidal sediments; (2) To determine hydrocarbon levels in the mussel Mytilus californianus; (3) To assess the partitioning of petroleum and related compounds between mussels and seawater; and (4) To estimate trace metal concentrations and variability in intertidal organisms.

DESCRIPTION: Microbial biomass in the intertidal zone of six Southern California beaches was estimated by measurement of adenosine triphosphate (ATP). Coal Oil Point and San Nicolas Island were sampled intensively by taking surficial samples from upper, middle, and lower tide levels. Catalina Island, Government Point, San Diego, and Corona del Mar were sampled nonintensively at middle and lower tide heights and at four depth strata. Sediment cores were taken with an acrylic tube. Samples were then extracted in sulfuric acid. ATP was determined utilizing bioluminescent luciferase enzyme techniques. Mussels from nine island and three mainland sites were analyzed for hydrocarbon contents. Pooled (20 specimens) composite samples of gonads, gills, and gut were subjected to homogenation, saponification, and column chromatography. Gas chromatography and gas chromatography-mass spectroscopy were used to identify hydrocarbon compounds and mixtures. For seawater hydrocarbon analyses, water samples (1,000 l) were collected during a full tidal cycle from 200 m offshore at previously established Mylitus monitoring sites at Goleta Point, San Nicolas Island, and Corona del Mar. Water samples were filtered through glass fiber filters. Dissolved organics were extracted by adsorption on high density polyurethane foam adsorptive columns and by two-stage liquid-liquid extraction. Following extraction, hydrocarbons were analyzed using gas chromatography.

Mussel and kelp (Macrocystis) samples were collected from four sites: Coal Oil Point, Government Point, Corona del Mar, and San Nicolas Island during 1977-1978 and analyzed for leachable and total dissolved trace metal (cadmium, chromium, copper, lead, nickel, and zinc) concentrations using atomic absorption spectrophotometry. Barium and vanadium levels were determined using neutron activation analysis.

SIGNIFICANT CONCLUSIONS: ATP analysis should employ peak-height analysis rather than light-integration techniques. Microbial biomass estimates displayed variation among beaches and seasons. No major seasonal changes in hydrocarbon contamination were observed during the three year program; this observation obscures sporadic contamination observed in mussel samples from Southern California islands, so the islands should be sites of future monitoring efforts. Use of mussels as indicators for detecting petroleum pollution as well as other municipal/industrial pollutants continues to be valid. Dissolved and particulate water column hydrocarbon analysis revealed a diverse mixture of biogenic and petroleum-derived compounds. Partitioning of related compounds between seawater phases and mussels yielded a coefficient of the same order of magnitude. Mussels generally contained higher trace metal levels than kelp from the same sites. Numerous factors contribute to trace metal variability in macrobiota which hinder analytical resolution. Use of macrobiota as sensitive pollution indicators is limited. Future petroleum-related trace metal monitoring should focus on near-field dissolved, particulate, and sedimentary phases as pollution indicators.

STUDY RESULTS: ATP analysis proved a reliable and repeatable technique for estimating total microbial biomass in marine sediments. Total bacterial population estimates agreed with previous estimates derived from direct microscopic methods. Microbial biomass concentrations varied from summer to winter. Coal Oil Point displayed the highest values of the six beaches sampled. Macrofaunal biomass, sediment depth, and other within-site factors contributed to variability. Mytilus samples from mainland sites at Coal Oil Point, Government Point, and Corona del Mar displayed the highest concentrations of unresolved hydrocarbons, presumably due to natural oil seeps and anthropogenic inputs. Island samples showed generally low levels, with the exception of San Clemente and Santa Catalina Islands which contained significant levels of petrogenic hydrocarbons. Petroleum-derived hydrocarbons were low in mussels from San Miguel Island despite possible petroleum seeps in the area. Gut tissue contained the highest hydrocarbon levels compared with whole body, gill, and gonad levels. Seawater from Goleta Point displayed the highest hydrocarbon concentration in August 1978. With rare exception, hydrocarbon concentrations were greater in particulate phase than the dissolved phase of seawater sampled. Gas chromatograms of Mytilus extracts from San Nicolas Island more resembled chromotrograms of seawater particulates than those of the dissolved phase.

Macrocystis trace metal levels were generally much lower than for Mytilus. Highest nickel and cadmium values in mussels were recorded from San Nicolas Island while highest copper and lead values occurred in Corona del Mar samples. Coal Oil Point mussels exhibited low levels of cadmium, chromium (summer), lead, and zinc compared with other sites, but kelp in this area had high nickel, cadmium, and chromium (summer) concentrations. No clear geographic trends were established with respect to barium or vanadium in kelp, but mussels displayed geographical and seasonal concentration trends for both metals. Factors contributing to trace metal variability in intertidal organisms included: geographic location, sediment mineralogy, sediment inclusion in tissues, anthropogenic input, season, and tissue selectivity. Aluminum concentration values can be used to estimate the amount of barium and vanadium in Mytilus due to sediment inclusion. For Macrocystis, the significance of particulate metals entrained within the mucoid sheath could not be directly determined.

STUDY PRODUCT(S): Holm-Hansen, O., W. H. Lippincott, and A. D. Oesterle. 1979. Intertidal Study of the Southern California Bight. Vol. II, Report 13.0 - Microbial Biomass (ATP) in Sediments. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB80-143753/AS. Contract No. AA550-CT7-44. 14 pp.

Risebrough, R. W., B. W. deLappe, E. F. Letterman, J. L. Lane, A. M. Springer, and W. Walker, II. 1979. Intertidal Study of the Southern California Bight. Vol. II, Report 14.0 - Hydrocarbons in Intertidal Organisms of the Southern California Bight. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB80-143753/AS. Contract No. AA550-CT7-44. 54 pp.

deLappe, B. W., R. W. Risebrough, J. C. Shropshire, W. R. Sistek, E. F. Letterman, D. R. deLappe, and J. R. Payne. 1979. Intertidal Study of the Southern California Bight. Vol. II, Report 15.0 - The Partitioning of Petroleum and Related Compounds between the Mussel Mytilus californianus and Seawater in the Southern California Bight. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB80-143753/AS. Contract No. AA550-CT7-44. 55 pp.

Gordon, M., G. Knauer, and J. Martin. 1979. Intertidal Study of the Southern California Bight, Vol. II, Report 16.0 - Trace Metals in Marine Organisms. A final report by Science Applications, Inc. for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB80-143753/AS. Contract No. AA550-CT7-44. 70 pp.

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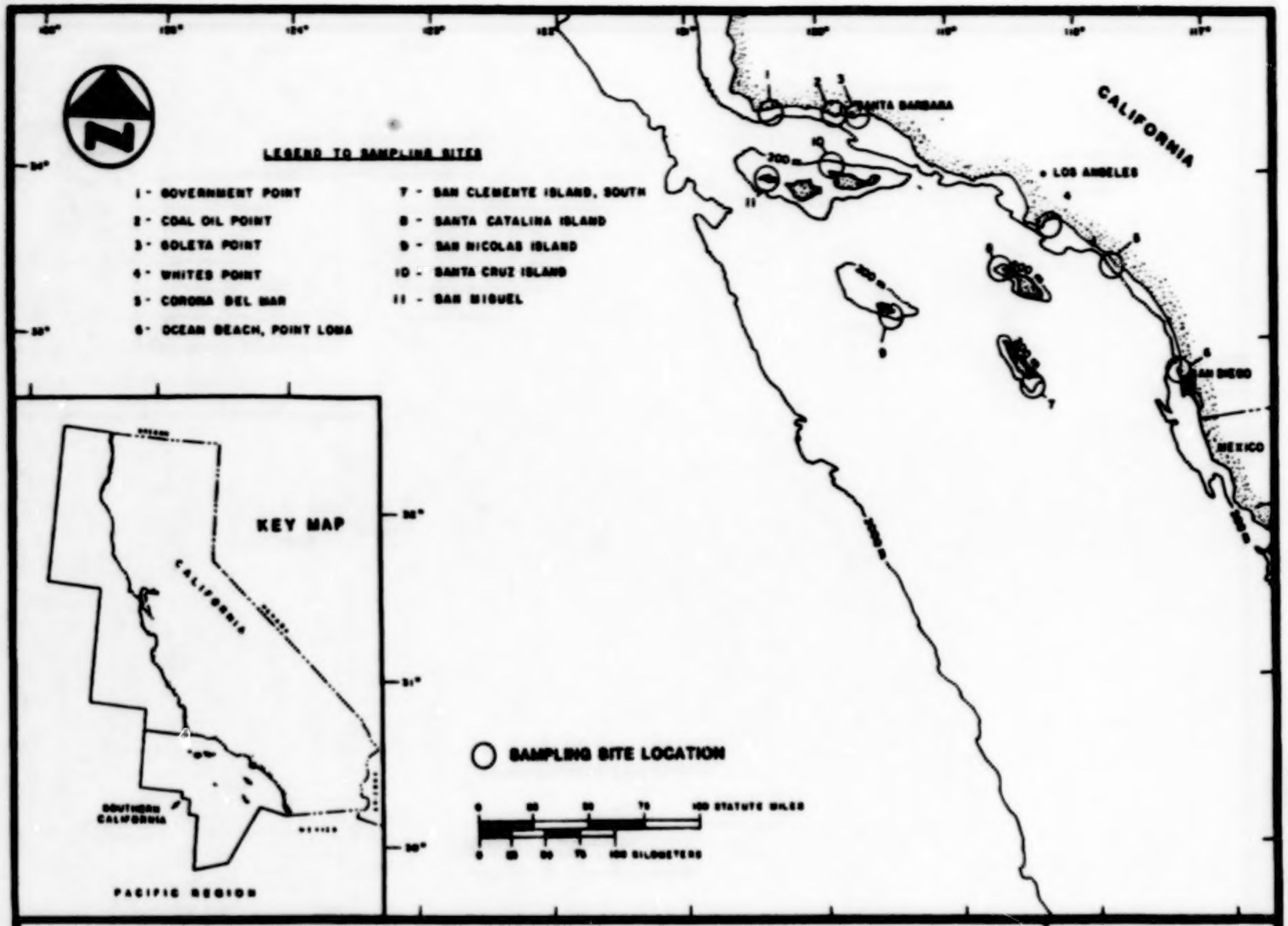

SAMPLING SITE LOCATIONS FOR THE SOUTHERN CALIFORNIA BASELINE STUDY, YEAR III.

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ACCESS NUMBER: **29082**

STUDY TITLE: Southern California Marine Mammal and Seabird Survey, Year III.

REPORT TITLE: Summary of Marine Mammal and Seabird Surveys of the Southern California Bight Area, 1975-1978. Vol. II, Summary and Synthesis of Findings.

CONTRACT NUMBER(S): BLM: C7-36; MMS: 14-12-0001-29082.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1977.

COMPLETION DATE OF REPORT: November 1978.

COST(S): FY 1977: $971,104; CUMULATIVE PROJECT COST: $2,652,005.

PROJECT MANAGER(S): T. Dohl.

AFFILIATION: The Center for Coastal Marine Studies.

ADDRESS: University of California, Santa Cruz, Santa Cruz, California 95064.

PRINCIPAL INVESTIGATOR(S)*: T. Dohl, G. Hunt, Jr., B. LeBoeuf, K. Norris.

KEY WORDS: Southern California; Southern California Bight; marine mammals; seabirds; distribution; seasonality; endangered species; threatened species; migration; plankton; photographs; aerial observations; radiotelemetry; population; abundance; pinnipeds; cetaceans; shipboard observations; mortality; tagging.

BACKGROUND: Studies supported by the U.S. Department of the Interior were conducted in the Southern California Bight over a three-year period from April 1975 through March 1978. These studies addressed the population status, distribution, seasonality, and ecology of the marine mammals and seabirds and were reported nominally in separate parts as: (1) Pinnipeds, (2) Seabirds, and (3) Cetaceans. The studies provided an information base for use by resource managers in their efforts to predict and minimize the potential impact to result from accelerated oil and gas activities on the outer continental shelf.

OBJECTIVES: (1) To determine which Southern California marine mammal and seabird populations are endangered, threatened, unique, or protected; (2) To identify habitats critical to the survival and wellbeing of these animals; (3) To identify oil and gas activities which are likely to affect the critical populations or habitats; and (4) To discuss ways to minimize or mitigate possible impacts.

DESCRIPTION: Study data were obtained during previous investigations that occurred from April 1975 through March 1978. Animal distributions and densities were sampled along aerial transects totaling over 136,600 linear km (73,240 NM) and along ship tracts totaling over 55,800 linear km (30,140 NM). An additional 3,300 km (1,780 NM) of ship transect work revealed patterns of seabird and sea lion foraging near important breeding sites. Adult birds were collected to determine molt, stomach contents, and body condition, and 46 plankton samples were collected at sea near important bird colonies to assess food availability. Movements and migratory patterns were investigated by radio tracking. Field crews spent over 2,100 person-days on pinniped rookeries and seabird colonies throughout the Channel

Islands to determine reproductive output of thousand of seabirds and seals, to measure growth rates and hundreds of young birds while collecting almost 900 seabird food samples, and to examine almost 500 juvenile seals that died of natural causes on rookeries. Observers searched 2,550 linear km (1,375 NM) of mainland and island shoreline, finding over 4,150 dead seabirds. Sighting records of 6,700 seals, 190,000 whales and propoises, and almost 1.75 million seabirds were amassed, together with 25,000 survey photographs of seabird and pinniped rookery areas.

SIGNIFICANT CONCLUSIONS: Pinnipeds: California sea lion number over 50,000 in the area during summer when pups are born. Northern elephant seal number over 12,000 in winter when they haul out for pupping and mating. Each of these species has over 40% of the world population centered among the area's islands. Guadalupe fur seal are rare in the area and breed only on Isla de Guadalupe, Mexico. Northern fur seal have established their only U.S. colony on San Miguel Island (population approximately 4,000). Harbor seal (estimated population 3,000) haul out on all islands and at many mainland locations. The Steller sea lion population has declined to very low numbers and is apparently still decreasing. Seabirds: Estimates of the total seabirds inhabiting the Southern California Bight at any give time range from 200,000 to 3,000,000 individuals and average 400,000 to 800,000. Peak abundance in winter and late spring coincides with occurrences of wintering and migrating species. The sightings list includes 71 species, of which two species (cape petrel and blue-faced booby) represent new sightings for the area. Nine species previously recorded were not seen. Numbers were highest in cooler shallow waters close to island or mainland shores. Difference in seawater temperature probably accounts for the apparent break in component species north and south of Pt. Conception. The avifauna of the study area is numerically dominated by species that are most abundant north of Pt. Conception. Mortality patterns, an accurate method of determining nearshore usage, allow for prediction of the natural occurrence of beached birds using numbers and seasonality. The study stresses the extreme importance and sensitivity of colonies on San Miguel, Anacapa, and Santa Barbara Islands and the need to protect ashy storm petrels, brown pelicans, and Xantus' murrelets and their foraging areas. Cetacea: Twenty-seven cetacean species were noted, including six baleen whale species, four toothed whale species, and 17 smaller dolphin and porpoise species. Only three or four cetacean species reside throughout the year within the study area; most pass through during annual migrations. Predictable concentrations of these migrants occur near the northern Channel Islands in spring and summer, along Santa Rosa Ridge and east of San Clemente Island near summer, and along the mainland coast and near Santa Catalina Island during winter. Winds, waves, water temperatures, and currents highly influence the seasonality, distribution and numbers of cetaceans for those warm-water or cold-water species. Climatic fluctuations appear to have little or no effect on migrating species.

STUDY RESULTS: The total pinniped population (land and sea) numbers 60,000 to 75,000 animals and is seasonally variable. Of the total, between 50 and 90% are California sea lion. Sea lions and fur seals are most abundant in summer and autumn. Northern elephant seal and harbor seal are most winter abundant during winter and spring. Northern elephant seal form breeding aggregations on San Miguel, San Nicolas, and Santa Barbara Islands. Concurrently, northern fur seal (pelagic migrants from the Bering Sea) become common at low density west of the Patton Escarpment. In spring, harbor seal pup and breed on most offshore islands, especially on the northern island chain and on San Nicolas Island. Northern elephant seal pups disperse to sea in March and April as many adult and juvenile animals haul out to molt. In summer, California sea lion, northern fur seal, and Steller sea lion pup and breed on San Miguel Island. California sea lion also pup and breed on San Nicolas, Santa Barbara, and San

Clemente Islands. In autumn, breeding populations disperse to sea and begin exploiting seasonally-abundant food resources in parts of the study area sparsely occupied during the breeding season, or immigrate to parts of their range beyond the limits of the study area.

The computer data base includes 97,000 records (sightings) of 1,600,000 individual birds; counts not entered into the computer amounted to approximately 140,000, giving a total data base of about 1,740,000 birds. Of the 71 species of seabirds recorded 25 to 30 species were common or abundant in the study area, and 8 to 15 of these were representative in any given month. The remaining 45 to 50 species occurred rarely or so sporadically, never constiting more than 5% of the total avifauna. During daylight, 50 to 95% of all individuals can be expected over open water, 5 to 10% over the mainland, and 1 to 4% on the islands. Cormorants and pelicans never constituted more than 25% of the open-water or mainland beach fauna, but comprised up to 87% of the insular counts. In contrast, tubenoses rarely occurred over land, but made up to 92% of all birds seen over open water.

During the study period, 2,380 sightings of cetacea were recorded, totaling 188,356 individual animals. Due to differences in survey techniques, 43,538 animals recorded during the pinniped and marine bird programs and those from the cetacean ship surveys were not included in density computations. Eleven animals were fitted with radio transmitters, an effective technique which showed the proclivity for a general counterclockwise swim direction for some delphinids. The tagging effort, a qualified success, resulted in a return rate of 1.2% (691 tags placed, 8 resights). In general, cetacean species may be divided into four occurrence groupings: 1) Year-round Residents - Dahl's and Pacific white-sided porpoises, Risso's, bottlenose, common, and northern right whale dolphins, pilot whale and the less common killer, fin and beaked whales; 2) Seasonal Migrants - sperm, blue, humpback, and California gray whales, and probably the minke and sei whales; 3) Occasional Visitors - pygmy and dwarf sperm whales, false killer whale, and spotted, spinner, and streaked dolphins and 4) Rare Occurrences - right whale. The common dolphin was the most numerous cetacean, accounting for 73% of the total animals recorded. The Pacific white-sided dolphin ranked second in abundance (8.6%). The pilot whale was not as abundant as once thought. Seasonal concentrations in the San Pedro Channel and around Santa Catalina Island have led to overestimation; this study indicated a peak population of no more than 400 animals. The California gray whale increased in population size and showed a proclivity for increased offshore migration through the Southern California Bight. The minke whale is predominant in spring and summer and is the second most numerous baleen whale in the study area.

STUDY PRODUCT(S): Dohl, T. P., G. Hunt, B. LeBoeuf, and K. Norris. Summary of Marine Mammal and Seabird Surveys of the Southern California Bight Area, 1975-1978. Vol. II, Summary and Synthesis of Findings. A final report by the University of California, Santa Cruz for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB81177 164/AS. Contract No. AA550-CT7-36.

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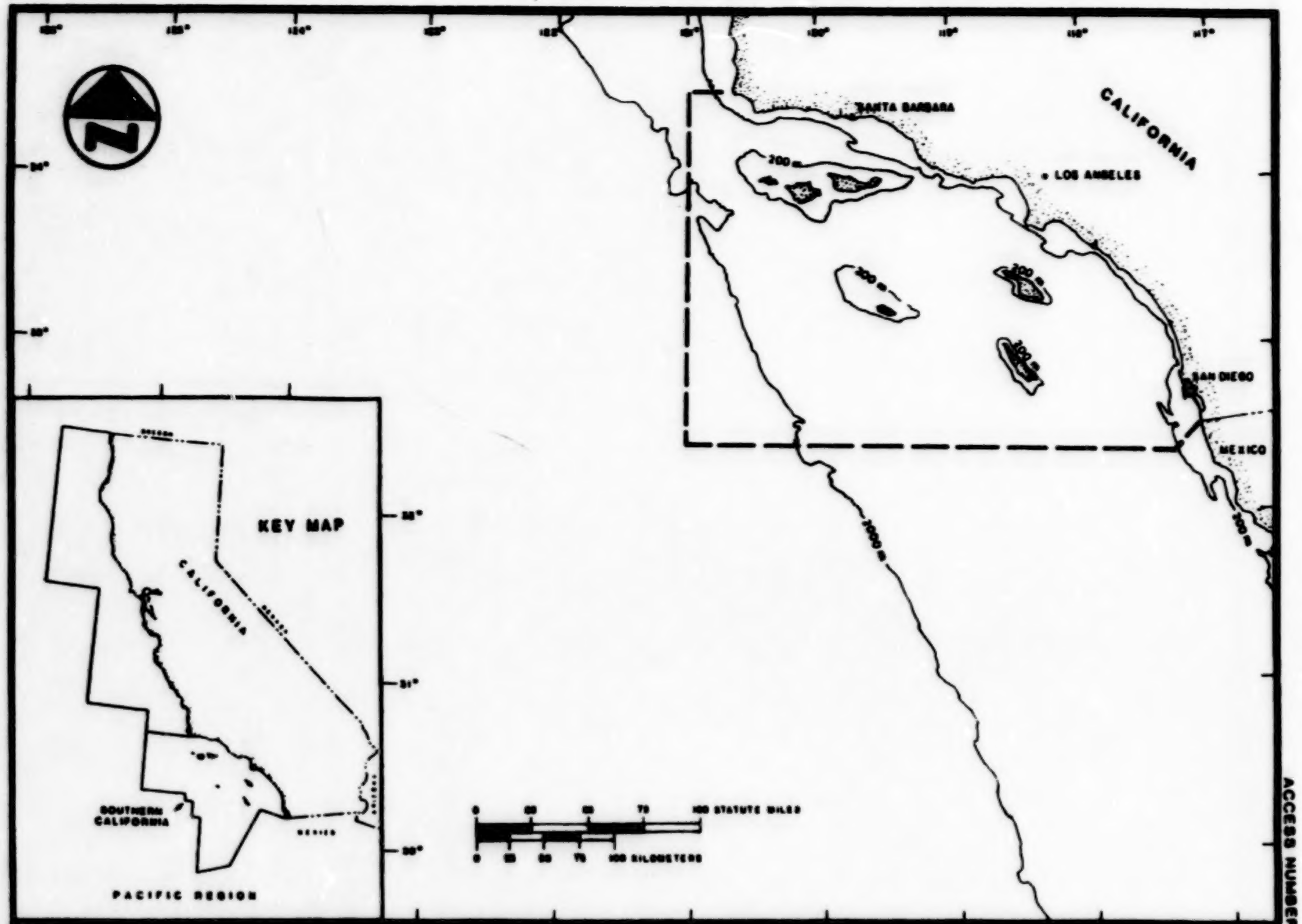

STUDY AREA SURVEYED DURING THE SOUTHERN CALIFORNIA MARINE MAMMAL AND SEABIRD SURVEY, YEAR III.

ACCESS NUMBER:29082

ACCESS NUMBER: 29082

104

ACCESS NUMBER: **29082.2**

STUDY TITLE: Southern California Marine Mammal and Seabird Survey, Year III.

REPORT TITLE: Summary of Marine Mammal and Seabird Surveys of the Southern California Bight Area, 1975-1978. Vol. III, Investigators' Reports, Part I, Pinnipeds.

CONTRACT NUMBER(S): BLM: C7-36; MMS: 14-12-0001-29082.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1977.

COMPLETION DATE OF REPORT: November 1978.

COST(S): FY 1977: $971,104; CUMULATIVE PROJECT COST: $2,652,055.

PROJECT MANAGER(S): T. Dohl.

AFFILIATION: The Center for Coastal Marine Studies.

ADDRESS: University of California, Santa Cruz, Santa Cruz, California 95064.

PRINCIPAL INVESTIGATOR(S)*: T. Dohl, G. Hunt, Jr., B. LeBoeuf, K. Norris.

KEY WORDS: Southern California; Southern California Bight; marine mammals; pinnipeds; distribution; abundance; shipboard observations; aerial observations; seasonality; mortality; photographs; population; tagging; migration.

BACKGROUND: Pinnipeds (seals and sea lions) have been reported in the Southern California area since the time of Spanish and English explorers in the 16th century. During the early 19th century, entire pinniped populations were destroyed by Russian and American sealers. In general, the 20th century has been a period of recovery. Censuses were begun in the early 1900s, but most have not been taken at the most propitious time of the year. Consequently, many early censuses give a distorted picture of the number of seals and sea lions that were present in the area. This study was funded to detect and describe patterns of seal and sea lion use of the Southern California Bight in sufficient detail to provide a benchmark against which the impact of man's activities in the Southern California Bight might be measured.

OBJECTIVES: (1) To describe the pinniped species present in the Southern California Bight and how their numbers vary seasonally; (2) To determine whether pinniped populations are growing, declining, or stablizing; (3) To determine the number of pups born each year and the expected natural mortality range; and (4) To determine foraging and haul-out areas.

DESCRIPTION: Sightings at sea were made during shipboard and aerial surveys. From May 1975 through March 1978, a total of 27 standard aerial surveys, 25 standard ship surveys, and 4 ship surveys of far offshore waters were conducted. In general, flights and cruises alternated at three- to four-week intervals. Eight aerial transects along north-south lines separated by 30 min of longitude were followed from the coast south to 32 20'N lat. Usually two or four transects were flown daily until the eight were completed. Additional transect lines designed to investigate high density areas were surveyed as time permitted. Surveys were flown at a ground speed of 90 to 100 kn and an altitude of 60 m. Observations were made only on one side of the aircraft. Data recorded included: sighting time, age, sex, behavior, inter-specific associations, movement direction, and declination from horizontal to sighting. Ship observations were made on 99 segments of 4 NM each over a track of 501 NM long. The track included radial transects around Santa Barbara Island and other islands on an opportunistic basis. Observations were made 6 m above the water on both sides of the ship with the unaided eye followed with binoculars for identification and data recording. Sightings within 600 m at 90 from the ship's heading were included in density counts. Data recorded were the same as for aerial surveys. Aerial photographic censuses of land were carried out within the same four-day period used for open-water surveys. Aerial censuses were supplemented by on-foot visits to hauling grounds and were made with binoculars.

Sighting data were entered onto computer disk, stored on tape, and manipulated by a variety of programs designed for specific tasks. Shipboard and aerial sightings were transformed to density estimates using a modification of a standard line-transect density estimator. Pinnipeds on land were counted from the approximately 1,000 aerial photographs taken during each survey. Censusing, tagging, and special studies of natality/mortality were carried out by teams in residence on rookery islands.

SIGNIFICANT CONCLUSIONS: California sea lion and northern elephant seal populations are healthy, growing, and occur in great numbers on rookery islands in the Southern California Bight during their annual breeding seasons. California sea lion number over 50,000 in the Southern California Bight in summer months when pups are born. Northern elephant seal number over 12,000 in winter when they haul out for pupping and mating. Each of these species has over 40% of the world population centered among the Southern California Bight islands. Once the most abundant pinnipeds in the Southern California Bight, Guadalupe fur seal are rare in the area and breed only on Isla de Guadalupe, Mexico. Northern fur seal have established their only U.S. colony on San Miguel Island with a population of approximately 4,000 animals. Harbor seal, whose estimated population of 3,000 animals is growing slowly, haul out on all Southern California Bight islands and at many mainland locations. The last of the six pinnipeds inhabiting the Southern California Bight is the Steller sea lion, whose Southern California Bight population has declined to very low numbers and is apparently still decreasing.

STUDY RESULTS: The total pinniped population of the Southern California Bight in 1978, including animals on land and at sea, numbered 60,000 to 75,000 animals and was seasonally variable. Of the total, between 50 and 90% were California sea lion. Sea lions and fur seals were most abundant in summer and autumn. Northern elephant seal and harbor seal were most abundant during winter and spring.

In winter, northern elephant seal formed breeding aggregations on San Miguel, San Nicolas, and Santa Barbara Islands. Concurrently, northern fur seal became common at low density in waters west of the Patton Escarpment; these animals were pelagic migrants from the Bering Sea.

In spring, harbor seal were observed to pup and breed on most Southern California Bight islands, but especially on the northern island chain and on San Nicolas Island. Northern elephant seal pups dispersed to sea in March and April as many adult and juvenile animals hauled out to molt. In summer, California sea lion, northern fur seal, and Steller sea lion were observed to pup and breed on San Miguel Island. California sea lion also were observed to pup and breed on San Nicolas, Santa Barbara, and San Clemente Islands. In autumn, breeding populations disperse to sea and began exploiting seasonally-abundant food resources in parts of the Southern California Bight sparsely occupied during the breeding season, or immigrated to parts of their range which lay beyond the limits of the Southern California Bight.

STUDY PRODUCT(S): Bonnell, M. L., B. J. LeBoeuf, M. O. Pierson, D. H. Dettman, G. D. Farrens, and C. B. Heath. 1978. Pinnipeds of the Southern California Bight, Vol. III, Part I. In: Summary of Marine Mammal and Seabird Surveys of the Southern California Bight Area. A final report by the University of California, Santa Cruz for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS, Los Angeles, CA. NTIS No. PB81248171. Contract No. AA550-CT7-36. 535 pp.

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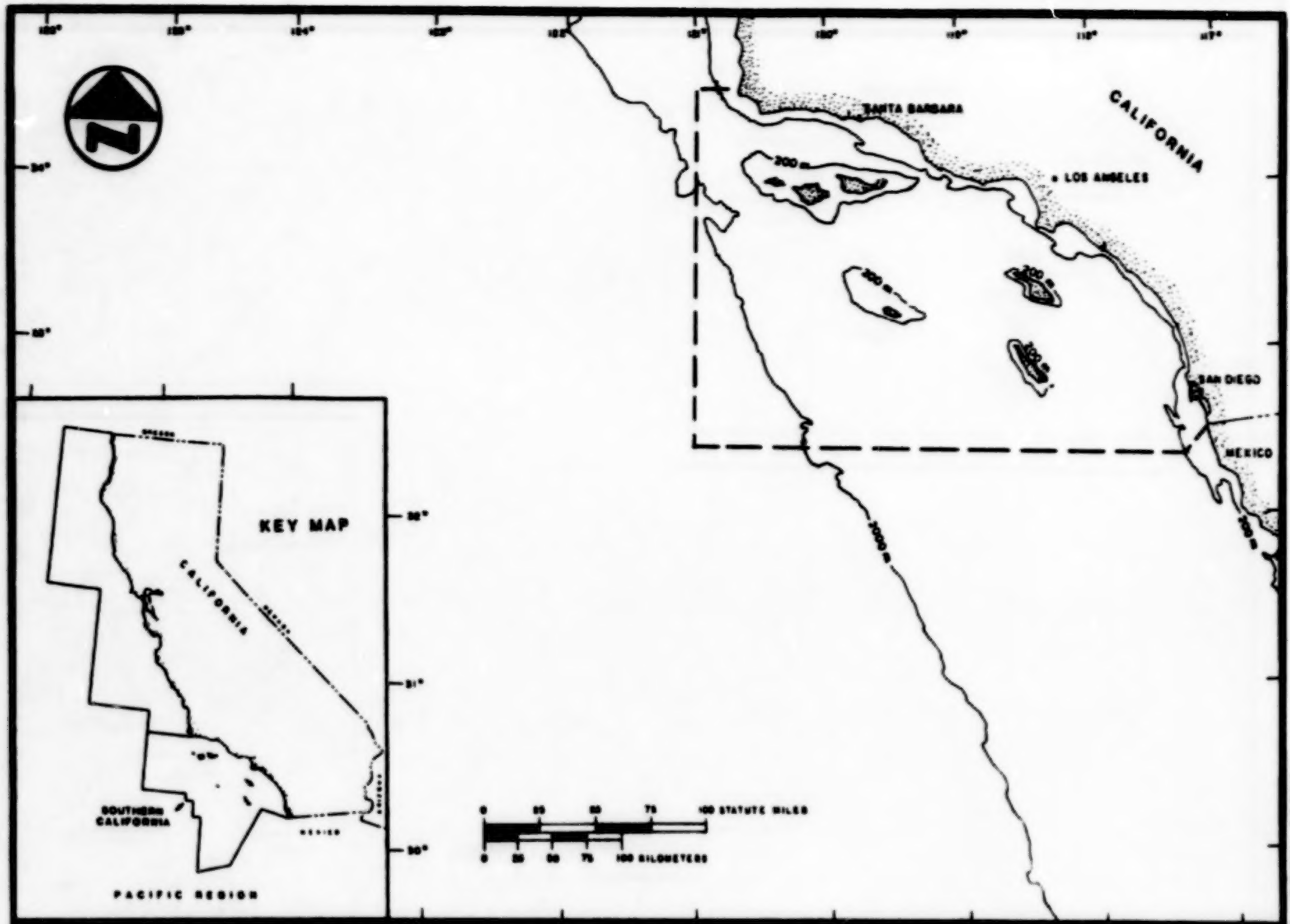

STUDY AREA SURVEYED DURING THE SOUTHERN CALIFORNIA MARINE MAMMAL AND SEABIRD SURVEY, YEAR III.

ACCESS NUMBER: 29082.2

108

ACCESS NUMBER: 29082.2

ACCESS NUMBER: **29082.3**

STUDY TITLE: Southern California Marine Mammal and Seabird Survey, Year III.

REPORT TITLE: Summary of Marine Mammal and Seabird Surveys of the Southern California Bight Area, 1975-1978. Vol. III, Investigators' Reports, Part II, Cetacea of the Southern California Bight.

CONTRACT NUMBER(S): BLM: C7-36; MMS: 14-12-0001-29082.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1977.

COMPLETION DATE OF REPORT: November 1978.

COST(S): FY 1977: $971,104; CUMULATIVE PROJECT COST: $2,652,055

PROJECT MANAGER(S): T. Dohl.

AFFILIATION: The Center for Coastal Marine Studies.

ADDRESS: University of California, Santa Cruz, Santa Cruz, California 95064.

PRINCIPAL INVESTIGATOR(S)*: T. Dohl, G. Hunt, Jr., B. LeBoeuf, K. Norris.

KEY WORDS: Southern California; Southern California Bight; marine mammals; cetaceans; distribution; abundance; aerial observations; shipboard observations; seasonality; population; radiotelemetry; tagging; migration.

BACKGROUND: This cetacean study was part of a large investigation conducted over a three-year period and designed to provide vital information on the population status, distribution, seasonality, and ecology of Southern California Bight mammals and seabirds. Benchmark data necessary to provide a background against which future population changes could be assessed were not previously available. Without such data, there would be no way to predict, minimize, or prevent unnecessary impacts due to accelerated oil and gas activities on the Southern California Bight outer continental shelf.

OBJECTIVES: (1) To detect and describe patterns of cetacean usage of the Southern California Bight on an annual and seasonal basis; and (2) To ascertain if cetacean populations are growing, declining, or stable.

DESCRIPTION: Data collection methods included aerial and shipboard surveys and tagging, marking, and tracking of individual specimens. Aerial transects were conducted monthly along each of 15 equidistant parallel lines extending from shoreline on a heading of 210 for varying distances of 30 to 120 NM seaward. Transect lines were spaced 15 NM apart beginning at Pt. Arguello in the north and terminating at the U.S.-Mexican border in the south. Photographic equipment included a 9-in format vertically mounted KA-2 cartographic camera, a Nikon motor driven 35 mm camera, and a 5-in K-22 Fairchild hand-held camera. Color film was used. Lens choice was determined by the altitude flown. The shipboard survey was directed to areas of known or suspected cetacean activity. A total of 34 regular shipboard trips were made during the survey period. Five special trips were made to survey the offshore waters outside the standard area to ascertain the populations present and perhaps underrepresented in the standard Southern California Bight surveys. Tagging was accomplished opportunistically from the vessel. Colored tags coded by area were implanted with a crossbow or a 3-m tagging pole. Small delphinids were captured selectively for radio transmitter placement. Captured animals were cryo-branded on the dorsal surface just anterior to the blowhole with a code representing the area of capture.

Data analysis included dividing the area into 1,000 blocks of five minutes latitude by five minutes longitude. Chi-square was used to determine if such features as water depth, distance from shore, sea temperature, etc. were adequately represented along sampling tracts. Stepwise multiple linear regression programs were used to detect and rank environmental factors which related significantly to variation in cetacean density. Population densities were estimated using several assumptions along with a modification of the index of abundance used by U.S. Fish and Wildlife Service in their Alaska bird surveys.

SIGNIFICANT CONCLUSIONS: Twenty-seven cetacean species inhabit Southern California Bight waters, including six baleen whale species, four toothed whale species, and 17 smaller dolphin and porpoise species. Only three or four cetacean species reside throughout the year within the Southern California Bight; most pass through during annual migrations. Many migrants move inshore or toward the tropics in winter and travel to cooler, more productive waters in summer. Predictable concentrations of these migrants occur near the northern Channel Islands in spring and summer, along Santa Rosa Ridge and east of San Clemente Island near summer, and along the mainland coast and near Santa Catalina Island during winter. Winds, waves, water temperatures, and currents highly influence the seasonality, distribution and numbers of cetaceans for those species that are nominally known as warm-water or cold-water preferring animals. These climatic fluctuations appear to have little or no effect on species (sperm, fin, blue, and gray whale) migrating through the Southern California Bight.

STUDY RESULTS: During the study period, 2,380 sightings of cetacea were recorded, totaling 188,356 individual animals. Of this total, 43,538 animals were recorded during the pinniped and marine bird programs. These latter data and those from the cetacean ship surveys were not included in density computations due to differences in survey techniques.

Eleven animals were captured and equipped with radio transmitters. The transmitters were excessive in weight and size and did not function as advertised. Nevertheless, the technique proved to be effective and possibly showed the proclivity for a general counterclockwise swim direction for some delphinids.

The tagging effort was judged as a qualified success. At the onset, a 1% return rate of resights was considered as an acceptable standard; the return rate for this study was 1.2% (691 tags placed, 8 resights).

In general, cetacean species may be divided into four broad groupings, based on occurrence within the Southern California Bight: 1) Year-round Residents - Dahl's and Pacific white-sided porpoises, Risso's, bottlenose, common, and northern right whale dolphins, pilot whale and the less commonly noted killer, fin and beaked whales; 2) Seasonal Migrants - sperm, blue, humpback, and California gray whales, and probably the minke and sei whales; 3) Occasional Visitors - pygmy and dwarf sperm whales, false killer whale, and spotted, spinner, and streaked dolphins usually found offshore or in Mexican waters; and 4) Rare Occurrences - right whale normally found no further south than Oregon. The common dolphin was the most numerous cetacean in the Southern California Bight, accounting for 73% of the total animals recorded. The Pacific white-sided dolphin was ranked second in abundance, accounting for 8.6% of the animals sighted. The pilot whale was not as abundant as once thought. Seasonal concentrations in the San Pedro Channel and around Santa Catalina Island have led to overestimation; this study indicated a peak population of no more than 400 animals. The California gray whale increased in population size and showed a proclivity for increased offshore migration through the Southern California Bight. It is unknown if this has been triggered by increased human activity in the Bight. The minke whale is predominant in spring and summer and is the second most numerous baleen whale in the Southern California Bight next to the gray whale.

STUDY PRODUCT(S): Dohl, T. P., K. S. Norris, R. C. Guess, J. D. Bryant, and M. W. Honig. 1978. Cetacea of the Southern California Bight, Vol. III, Part II. In: Summary of Marine Mammal and Seabird Surveys of the Southern California Bight Area, 1975-1978. A final report by the University of California, Santa Cruz for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB81248189. Contract No. AA550-CT7-36. 414 pp.

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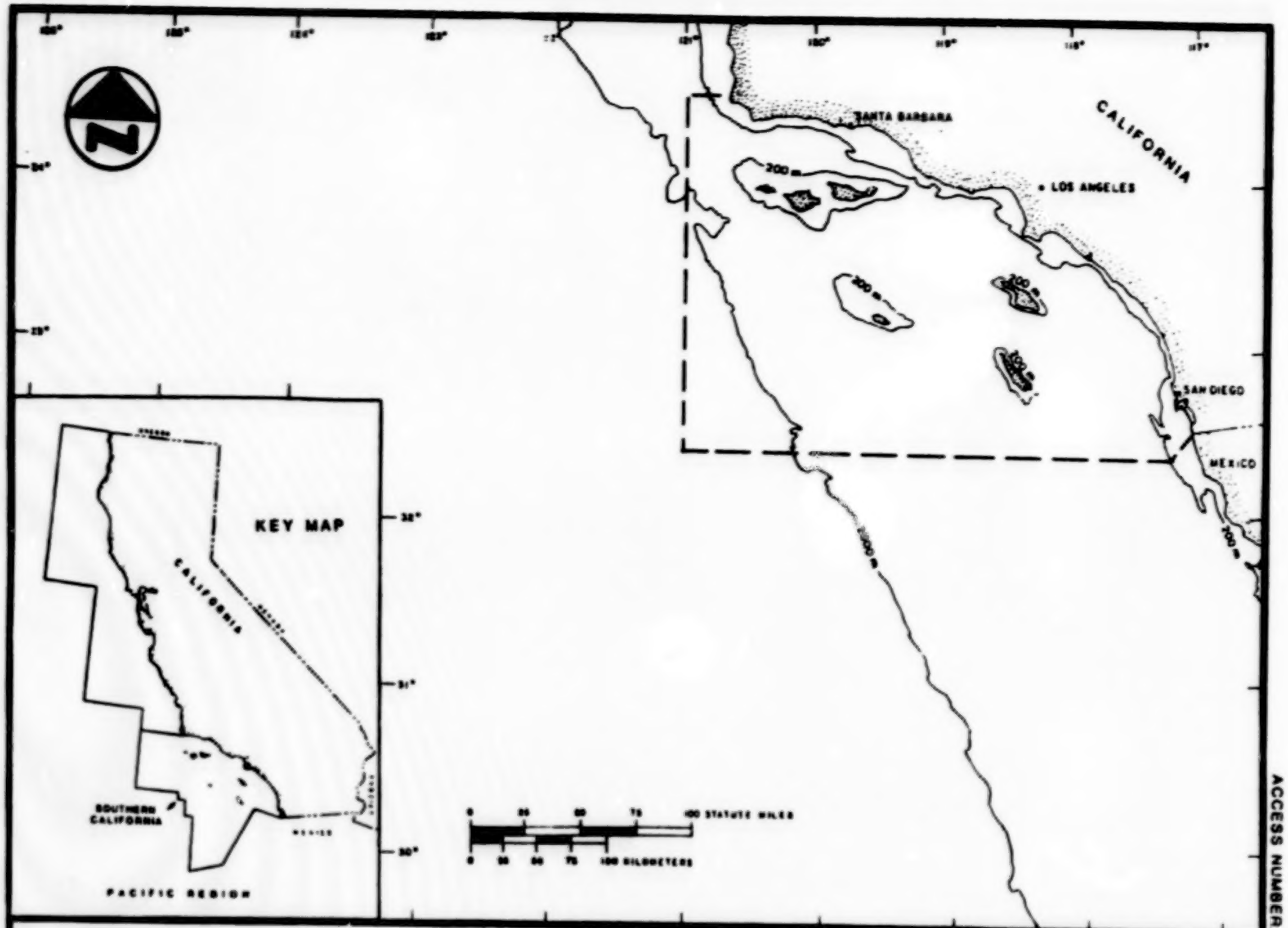

STUDY AREA SURVEYED DURING THE SOUTHERN CALIFORNIA MARINE MAMMAL AND SEABIRD SURVEY, YEAR III.

ACCESS NUMBER: 29082.3

ACCESS NUMBER: 29082.3

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ACCESS NUMBER: **29082.4**

STUDY TITLE: Southern California Marine Mammal and Seabird Survey, Year III.

REPORT TITLE: Summary of Marine Mammal and Seabird Surveys of the Southern California Bight Area, 1975-1978. Vol. III, Investigator's, Reports, Part III, Seabirds, Books I and II.

CONTRACT NUMBER(S): BLM: CT7-36; MMS: 14-12-0001-29082.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1977.

COMPLETION DATE OF REPORT: November 1978.

COST(S): FY 1977: $971,104; CUMULATIVE PROJECT COST: $2,652,055.

PROJECT MANAGER(S): T. Dohl.

AFFILIATION: The Center for Coastal Marine Studies.

ADDRESS: University of California, Santa Cruz, Santa Cruz, California 95064.

PRINCIPAL INVESTIGATOR(S)*: T. Dohl, G. Hunt, Jr., B. LeBouef, K. Norris.

KEY WORDS: Southern California; Southern California Bight; seabirds; distribution; abundance; population; seasonality; migration; mortality; shipboard observations; tagging; radiotelemetry; aerial observations.

BACKGROUND: A data base of "normal" seabird population fluctuations is needed to understand and judiciously manage oil and gas development along with the seabird ecology of the Southern California Bight. Information on the numbers and reproductive ecology of nesting seabirds is of critical importance in assessing and minimizing potential risks of offshore development. Reproductive success of seabirds is subject to pronounced variations and is often correlated with the availability of specific food resources. Loss of a single years reproductive output may have a major impact on the population. Long-term depression of reproductive success, which could be caused by depletion of food resources due to oil development, may lead to a precipitous decline in population size from which populations may not recover.

OBJECTIVES: (1) To determine the annual abundance and species composition of the marine avifauna on mainland and Channel Island shorelines and at sea; (2) To document population movements and migratory pathways within the Southern California Bight; (3) To relate seasonal changes in species composition and distribution to measureable environmental factors; (4) To determine an index of mortality for seabirds through occurrence of dead or dying beached birds; (5) To investigate the reproductive ecology of nesting seabirds; and (6) To determine correlations between reproductive success and availability of food and foraging areas.

DESCRIPTION: Field surveys of the Southern California Bight were conducted for 36 months. Regular ship cruises were scheduled at approximately three- to six-week intervals during breeding seasons. At these times, inshore surveys and radial transects were completed, and seabird colonies were visited by research teams on foot. Prince Island has the largest seabird colony in the Southern California Bight and was visited each trip; other colonies were visited less often. Supplemental information for all Channel Islands (except Anacapa Island) was obtained from periodic airplane surveys. Photographs and counts of nesting colonies and roost areas were made from the airplane. A banding program was initiated. Adults were usually captured with mist nets or snared with hand-held monofilament, whereas young were hand caught in their nests. Captured individuals were banded with standard U.S. Fish and Wildlife Service bands and released after recording necessary information. Stomach contents of birds collected at sea were analyzed. Food samples were collected from nestings and from adults returning with food for young. Items in each sample were identified to the lowest possible taxon. Three complementary methods were used to identify foraging grounds: (1) ship surveys including onshore surveys and radial transects, (2) color marking of nesting birds, and (3) radiotelemetry of nesting birds.

Data analysis utilized computer output for each survey and included: (1) species sightings and numbers of individuals, (2) total number of birds observed, (3) maps of seabird density, and (4) environmental factors. Stepwise linear regression programs were used to rank significance of environmental variation with seabird density. Total population counts were derived by adding mainland, island, and at-sea counts. Mainland counts were obtained by taking actual density of the area surveyed (11% of the mainland shore) and extrapolating these data to total mainland counts. Island counts were considered complete and thus were used as recorded. At-sea counts were determined by: (1) a method similar to that used for mainland total counts, and (2) computer-projected abundance based on functions obtained from the environmental linear regression equations.

SIGNIFICANT CONCLUSIONS: The marine avifauna of the Southern California Bight is both large and complex. Estimates of the total seabirds inhabiting the Southern California Bight at any give time range from 200,000 to 3,000,000 individuals and average 400,000 to 800,000. Areas and seasons have been identified in which seabirds concentrate and those in which they are scarce. Peak abundance in winter and late spring coincides with occurrences of wintering and migrating species. The sightings list includes 71 species, of which two species (cape petrel and blue-faced booby) represent new sightings for the area. Nine species recorded in the literature for this area were not seen during this study. Seabird density was predicted most accurately on the basis of variation in distance from the mainland, distance from nearest land, water depth, and water temperature. Numbers were highest in shallow waters having the coolest temperatures and close to island or mainland shores. The Southern California Bight avifauna is approximately as diverse as that of Central and Northern California and is probably comparable to that of the Baja California coast. Difference in seawater temperature probably accounts for the apparent break in component species north and south of Pt. Conception. The avifauna of the Southern California Bight is numerically dominated by species that are most abundant north of Pt. Conception. Mortality patterns are an accurate method of determining nearshore usage of the Southern California Bight, and it is possible to predict the natural occurrence of beached birds based upon their numbers and seasonality. The study stresses the extreme importance and sensitivity of colonies on San Miguel, Anacapa, and Santa Barbara Islands and the need to protect, in particular, ashy storm petrels, brown pelicans, and Xantus' murrelets and their foraging areas.

STUDY RESULTS: During the three-year study, an average of 10.8% of the total mainland beach frontage was surveyed 35 times; total beach frontage surveyed was 1,703 lin km. Survey coverage of the Channel Islands was variable; an average of 21.5 surveys was carried out at each of the islands from the air; shipboard surveys varied from 0 to 21 visits per island, averaging about 11 visits. Shipboard surveys included 8,337 lin km of transect lines during 1975-1976, 11,918 lin km during 1976-1977, and 8,579 lin km during 1977-1978. Aerial coverages over the open ocean were 12,962, 16,216, and 15,303 lin km for the time periods, respectively. The computer data base includes 97,000 records (sightings) of 1,600,000 individual birds; counts not entered into the computer amounted to approximately 140,000, giving a total data base of about 1,740,000 birds.

Of the 71 species of seabirds recorded in the Southern California Bight, 25 to 30 species were common or abundant in the study area, and 8 to 15 of these were representative in any given month. The remaining 45 to 50 species occurred rarely or so sporadically that they never constituted more than 5% of the total avifauna from a given survey. Estimates indicate that during daylight, 50 to 95% of all individuals can be expected over open water, 5 to 10% over the mainland, and 1 to 4% on the islands. Certain species groups were more common in one habitat than another. For example, cormorants and pelicans never constituted more than 25% of the open-water or mainland beach fauna, but comprised up to 87% of the birds counted on islands. In contrast, tubenoses rarely occurred over land, but made up to 92% of all birds seen over open water. The bulk of the two volume report describes and discusses for each recorded species its numbers, distribution, seasonal pattern, reproductive ecology, foraging habits, and relative contribution to the total seabird fauna.

STUDY PRODUCT(S): Briggs, K. T., E. W. Chu, D. B. Lewis, W. B. Tyler, R. L. Pitman, and G. L. Hunt, Jr. 1978. Distribution, numbers, and seasonal status of seabirds of the Southern California Bight, Vol. III, Part III, Book I, Chapter I. In: Summary of Marine Mammal and Seabird Surveys of the Southern California Bight Area, 1975-1978. A final report by the University of California, Santa Cruz for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB81248197. Contract No. AA550-CT7-36. 307 pp.

Hunt, G. L., Jr., R. L. Pitman, M. Naughton, K. Winnett, A. Newman, P. R. Kelly, and K. T. Briggs. 1979. Reproductive ecology and foraging habits of breeding seabirds, Vol. III, Part III, Book II. In: Summary of Marine Mammal and Seabird Surveys of the Southern California Bight Area, 1975-1978. A final report by the University of California, Santa Cruz for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB81248205. Contract No. AA550-CT7-36. 399 pp.

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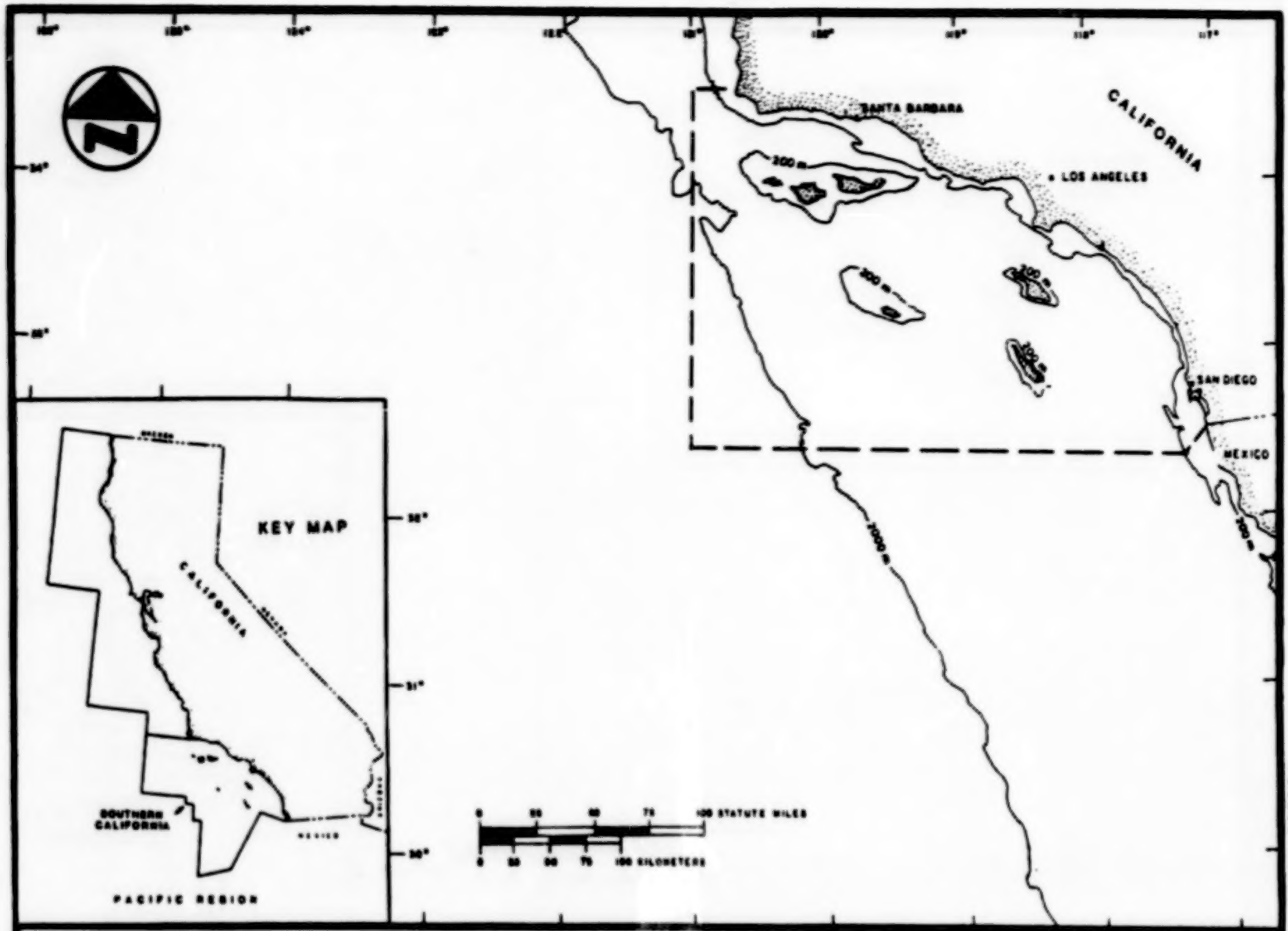

STUDY AREA SURVEYED DURING THE SOUTHERN CALIFORNIA MARINE MAMMAL AND SEABIRD SURVEY, YEAR III.

ACCESS NUMBER: 29082.4

ACCESS NUMBER: **29087**

STUDY TITLE: Biological and Geological Reconnaissance and Characterization Survey of the Tanner and Cortes Banks.

REPORT TITLE: Biological and Geological Reconnaissance and Characterization Survey of the Tanner and Cortes Banks. Vol. I, Executive Summary; Vol. II, Synthesis of Findings.

CONTRACT NUMBER(S): BLM: CT8-43; MMS: 14-12-0001-29087.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1978.

COMPLETION DATE OF REPORT: September 1979.

COST(S): FY 1978: $658,166; CUMULATIVE PROJECT COST: $658,166.

PROJECT MANAGER(S): G. Bane.

AFFILIATION: Interstate Electronics Corporation.

ADDRESS: 1001 East Ball Road, P.O. Box 3117, Anaheim, California 92803.

PRINCIPAL INVESTIGATOR(S)*: P. Day, D. Hardin, A. Lissner, W. Merselis, N. Plutchak, K. Stoddard.

KEY WORDS: Southern California; Tanner-Cortes Banks; Santa Rosa-Cortes Ridge; biology; benthos; characterization; survey; maps; distribution; abundance; geology; bathymetry; submersible; benthic photographs; videotapes; hard-bottom; epifauna; sonar; community; fish.

BACKGROUND: The U.S. Department of the Interior initiated baseline environmental studies on the southern California outer continental shelf in 1975 to support area-specific management decisions regarding oil and gas activities. The studies included Tanner and Cortes Banks, two unique topographical features located 150 km southwest of Los Angeles, California. This study provides descriptive data useful in evaluating the sensitivity of these banks to potential oil and gas related impacts.

OBJECTIVES: (1) To observe and map the distribution, composition, and relative abundance of the dominant benthic biological communities found around five rocky outcrop areas on Tanner and Cortes Banks, and two rocky outcrop areas in deeper waters adjacent to the Banks and on the Santa Rosa-Cortes Ridge; and (2) To characterize and map salient geological features of Tanner and Cortes Banks, and on the Santa Rosa-Cortes Ridge.

DESCRIPTION: Surveys were executed in two sequential phases: Phase I, geological reconnaissance; and Phase II, biological reconnaissance. Phase I field surveys conducted from September to October 1978 sought to generate detailed geomorphic and bathymetric maps of selected regions and to aid in locating submersible transects for the Phase II surveys. Seven study areas were designated including Bishop Rock, Nine-Fathom Reef, Northwest Cortes Bank, Tanner and Cortes Trough, Central Tanner Bank, and Santa Rosa-Cortes Ridge. These areas were surveyed for bathymetry and geomorphology using fathometer and side-scan sonar. Precision navigation (ARGO calibrated with Mini-Ranger System) assured maintenance of preplotted trackline positions; navigational fixes were recorded at 100- or 200-m intervals along the tracklines which were spaced 200 m apart. Bathymetry was initially recorded using a Hydrocarta automated system and finished using fathometer and side-scan sonar. All soundings were plotted at 2-m contour intervals and mapped at 1:6,000 scale for draft and 1:12,000 scale for final reports.

Phase II biological reconnaissance surveys consisted of observational and photographic data obtained during manned submersible (NEKTON GAMMA) dives along transects selected during Phase I efforts. Two cruises conducted during October and November 1978 consisted of 21 dives and 16 dives, respectively. Photographic data were collected using hand-held 35-mm still, black and white videotape, and 16-mm movie cameras from inside the submersible. Additionally, an externally- mounted Benthos camera was set to automatically shoot a photograph every 43 seconds. These data were supplemented by direct observations made by cruise scientists which were recorded on audiotape and later transcribed into logbooks. Quantitative and qualitative species and community level evaluations of the videotapes and still photographs were made by teams of observers. Biological data included species density or occurrence vs depth or location for predominant species. An analysis of shared species along intersecting transects was used to verify consistency among the observations. Conspicuous biotal communities were mapped along survey tracklines and superimposed upon bathymetric and geomorphic maps.

SIGNIFICANT CONCLUSIONS: Geographic location coupled with convergence of favorable oceanographic conditions (upwelling, influence of the California Current, lower water temperature), rocky substrate, high water clarity, and unpolluted waters result in an area of high biological productivity around the Tanner and Cortes Banks region. Biotic assemblages were abundant and diverse including corals, echinoderms, fishes, molluscs, and sponges. Five major benthic community types (four hard-bottom, one sand bottom) and an additional eleven sub-communities were recognized. These communities were distributed among four depth ranges (14 to 40 m, 40 to 60 m, 60 to 89 m, and 89 to 149 m) with the most diverse and productive communities occurring in water depths of 60 m or less. The occurrence of species previously known only from more northern or southern waters indicates the importance of the Tanner and Cortes Banks as an area of distributional overlap. Depth ranges of many species and diversity of corals and other organisms demonstrates that the Banks act as an important refuge for many Southern California Bight organisms currently disappearing from more heavily impacted nearshore areas.

STUDY RESULTS: Side-scan sonar revealed seven generalized signatures related to a combination of topographic relief and bedrock lithology: undifferentiated surficial sediment veneer, reflective sediment veneer, low-relief rock with greater than 60% sediment veneer, low-relief rock with less than 60% sediment veneer, sedimentary rock, low-relief igneous rock, and high-relief igneous rock. The three study areas on Cortes Bank revealed high relief igneous rock surrounded by undifferentiated igneous and sedimentary rocks. The Bishop Rock area was the shallowest recorded for the study (4 m). Wave-cut terraces, protected areas, and areas between rock ridges were typically overlain by surficial sediments. Tanner Bank exhibited two areas of high-relief, igneous rocks surrounded by truncated sedimentary rock formations. Variable amounts of surficial sediment covered a central low relief area between Central Tanner Bank and Northwest Tanner Bank. Santa Rosa Ridge was deeper and less irregular than the other areas. Rocky outcrops at Santa Rosa Ridge protrude above a wave cut platform typically covered by boulders, cobbles, and sand. Thirty-seven submersible dives covered 95,250 m of seafloor transects. Four additional movie dives provided considerable descriptive biological data. Five major communities, four hard substrate and one sand bottom, distributed by depth and named for the predominant organism included the sea palm/erect coralline algae (Eisensia/Calliarthron) community (14 to 40 m depth range); large bladed brown algae (*Agarum/Laminaria*) community (40 to 60 m depth range); encrusting coralline algal community (60 to 89 m depth range); crinoid/brittle star (*Florometra*/ophiuroid) community (89 to 149 m depth range); and sand bottom community characterized by echinoids and asteroids (*Lytechinus*/asteroids) found at various depths. Differences among the seven surveyed areas were primarily due to depth. Subtle community differences were associated with rock relief and exposure relative to the northwesterly current regime. The presence of leafy algae also dictated distribution of associated biota. The greatest proliferation of sessile communities occurred on Cortes Bank with shallow areas such as Bishop Rock.

Fishes, abundant and diverse around rocky areas, included blackeyed gobies, blacksmith, convict fish, jack mackerel, ocean whitefish, several rockfish species, senoritas, and sheepshead. Mostly substrate-associated fishes were observed with rockfishes representing the most specious group with 28 species. High-relief areas attracted commercially important pelagic species such as jack mackerel, Pacific mackerel, and yellowtail. In general, fish assemblages exhibited wider depth ranges than the attached invertebrate/algal communities.

An important hydrocoral, *Allopora californica*, was widely distributed. This species reached peak abundance on northwestern, exposed boulder slopes and ridge tops below 30 m and mostly on sides of rock in shallower waters. The estimated standing crop biomass of this species for the study area was 350,000 kg. Three species of stony corals and 17 fan coral species were also observed in the study area.

STUDY PRODUCT(S): Interstate Electronics Corporation. 1979. Biological and Geological Reconnaissance and Characterization Survey of the Tanner and Cortes Banks. Vol. I, Executive Summary. A final report for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB82190745. Contract No. 14-12-0001-29087. 32 pp.

Interstate Electronics Corporation. 1979. Biological and Geological Reconnaissance and Characterization Survey of the Tanner and Cortes Banks. Vol. II, Synthesis of Findings. A final report for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB82190752. Contract No. 14-12-0001-29087. 133 pp.

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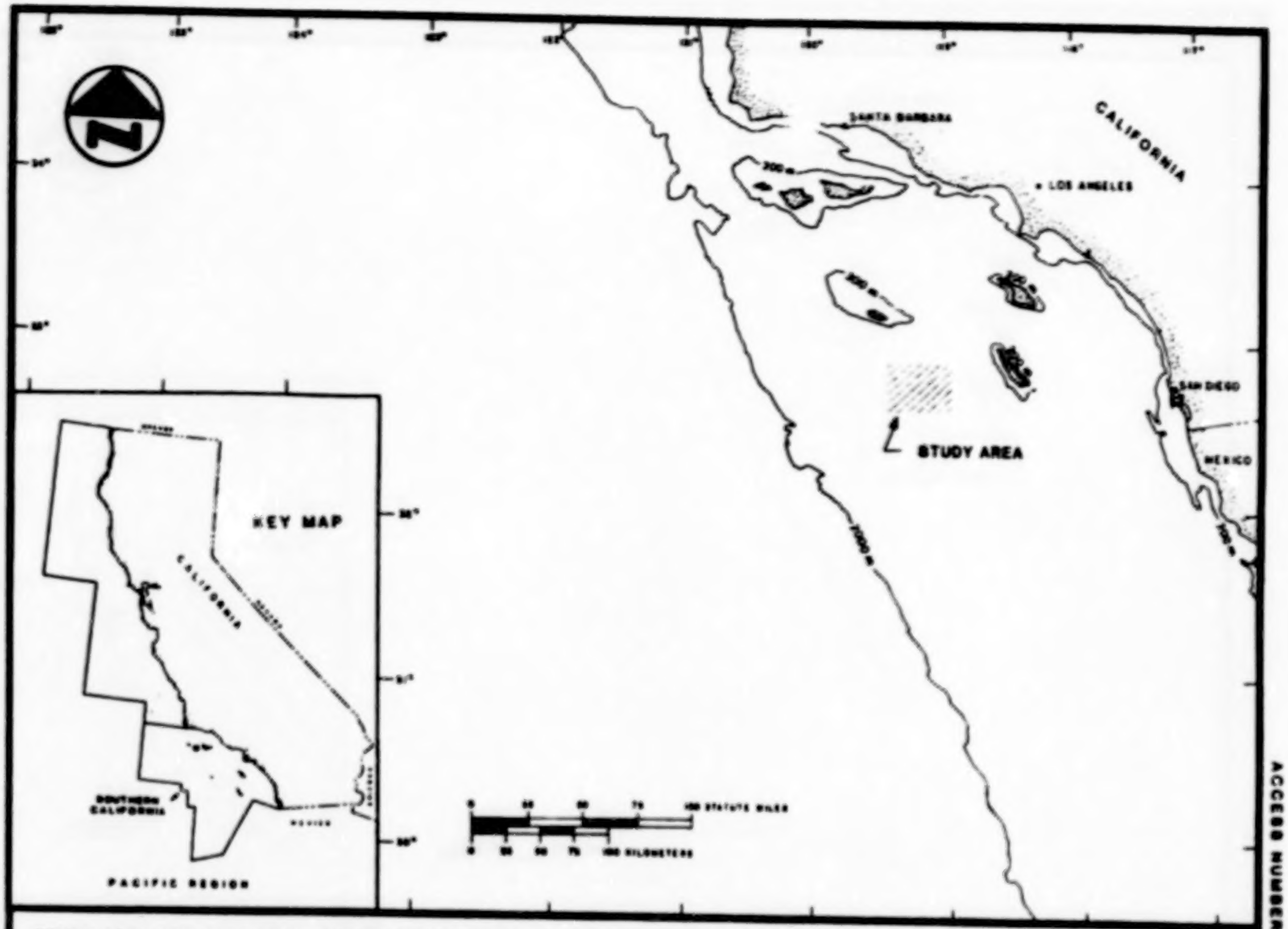

STUDY AREA FOR GEOLOGICAL AND BIOLOGICAL SURVEYS CONDUCTED ON TANNER AND CORTES BANKS, 1978.

ACCESS NUMBER: 29067

120

ACCESS NUMBER: **29090**

STUDY TITLE: Central and Northern California Marine Mammal and Seabird Study.

REPORT TITLE: Marine Mammals and Seabirds of Central and Northern California, 1980-1983: Executive Summary; Synthesis of Findings; Status, Abundance, and Distribution.

CONTRACT NUMBER(S): BLM: CT9-33; MMS: 14-12-0001-29090.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Central and Northern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1979; 1980; 1982.

COMPLETION DATE OF REPORT: August 1983.

COST(S): FY 1979: $3,202,918; FY 1980: $417,517; FY 1982: $1,300; CUMULATIVE PROJECT COST: $3,621,735.

PROJECT MANAGER(S): T. Dohl, W. Doyle.

AFFILIATION: The Center for Coastal Marine Studies.

ADDRESS: University of California, Santa Cruz, Santa Cruz, California 95064.

PRINCIPAL INVESTIGATOR(S)*: M. Bonnell, K. Briggs, T. Dohl.

KEY WORDS: Central and Northern California; Cape Mendocino; Point Sur; Monterey Bay; Trinidad Head; Morro Bay; Farallon Islands; Point Reyes; biology; marine mammals; seabirds; population; distribution; abundance; census; seasonality; habitat; aerial observations; aerial photographs; survey; shelf; slope; turtles; cetaceans; pinnipeds; endangered species; threatened species; maps.

BACKGROUND: The U.S. Department of the Interior (USDOI) funded baseline studies that assessed seabird and marine mammal populations in the Southern California Bight from 1975 to 1978. In 1979, a similar study was initiated for the northern and central California areas. Information generated during these investigations will be used by USDOI personnel when making decisions related to oil and gas activities on California's outer continental shelf (OCS).

OBJECTIVES: (1) To determine species composition, distribution, abundance, and seasonal variation for marine mammal and seabird populations; (2) To provide a description of habitat use; and (3) To identify areas of special biological importance to these populations on the central and northern California OCS.

DESCRIPTION: Coastal and offshore aerial surveys provided most of the abundance and distribution data for this study, although additional surveys were conducted from research vessels within restricted portions of the study area. From 1980 to 1983, monthly offshore aerial surveys were conducted consisting of 92 east-west transects spaced 5 min of latitude apart from Pt. Conception, California to the Oregon border and extending 185 km seaward. Some transects were flown twice during a month, once at 60-m altitude (for counts of smaller mammals and birds) and once at 300 m (to facilitate observation of large cetaceans) at an average speed of 165 km h^{-1}. For seabird density estimates along the flightlines, a 50-m sighting corridor was used. Observational data included time, location, species, and numbers of all seabirds or marine mammals sighted. When possible, behavior, direction of travel, and interspecific associations were noted. Also, environmental descriptions of the sea surface were noted by observers, and oceanographic data such as sea surface temperature (using a radiation thermometer) and chlorophyll concentration (using a radiometer) were recorded during the overflights. Additional aerial surveys were conducted quarterly each year along the coastline from Pt. Conception to the Oregon border at an altitude of 100 to 200 m with the flightline about 100 m seaward of the coastline. Observers on these flights used 35-mm cameras equipped with telephoto lenses to document aggregations of birds greater than 25 individuals. Five shipboard surveys were conducted in waters from Monterey Bay to Bodega Bay out to at least 100 km offshore. Observations and location information were recorded on audiotape during all surveys. Bird and mammal densities were calculated for 10 min segments of longitude along the transects and within three depth strata: shelf (0 to 199 m); slope (200 to 1,999 m); and offshore (greater than 2,000 m). Bird densities were calculated from flightlines using a 50-m corridor. Marine mammal densities were determined using inclinometer-measured angles transformed with a Fourier-series transformation. Statistical treatment of log transformed density data included regression, correlation, and principal components analyses. Overall data analysis centered on detecting, mapping, and describing seasonal changes in the abundance, distribution, and movement of the seabirds and marine mammals (cetaceans and pinnipeds) in central and northern California.

SIGNIFICANT CONCLUSIONS: Estimated seabird populations ranged from 1.4 to 6.4 million birds. Biomass density was more than an order of magnitude higher over the shelf than in coastal waters. In winter of 1982, bird populations were 69% lower than in preceding years; this was attributed to the onset of an El Nino event (influx of warm water) in the eastern tropical Pacific. Seabird densities and distributions in the northern and central California offshore waters exhibited various degrees of seasonality. Species composition resembled avifaunas from northern areas such as the Bering Sea. Important locations for seabirds were the colonies at the Farallon Islands, Point Reyes, Trinidad Head, and Klamath River at Castle Rock. Important pinniped areas included Ano Nuevo Island and the nearby mainland, the Farallon Islands, beaches and estuaries near Point Reyes, Mistake Point and Sugarloaf Rock near Cape Mendocino, and the rocks of St. George Reef. Offshore, most seabirds, sea lions, harbor seals, sea otters, and harbor porpoises were found over the shelf (less than 200 m water depths). Cetaceans were concentrated over the slope (less than or equal to 2,000 m water depths). Sperm whales and northern fur seals were found in offshore waters (greater than 2,000 m water depths). Significant populations of endangered or threatened seabird and marine mammal species included the brown pelican (30,000 birds), the California sea otter (1,300 adults), and several species of baleen whales (gray, fin, blue, and humpback). Most of the world's population of gray whales traverse the study area during winter and spring migrations.

STUDY RESULTS: During the three-year study approximately 124,000 linear km of aerial trackline were covered: 38,371 km in 1980, 41,394 km in 1981, 40,282 km in 1982, and 3,441 km in January 1983. The sampling effort was distributed as follows: 28% over shelf waters (1 to 199 m) and 45% over slope waters (200 to 1,999 m) and the remainder over offshore waters (greater than 2000 m). During 12 coastal overflights, 70,516 sightings of 1,221,289 birds were amassed. Coastal surveys resulted in more than 16,000 photographs and tens of thousands of sightings of more than 224,000 pinnipeds and 2.9 million seabirds. Five shipboard surveys covered 954 km of tracklines resulting in 4,947 sightings of 20,654 birds. Marine mammals sighted included 2,340 sightings of 3,819 seals and sea lions, and 4,575 sightings of 116,886 whales, dolphins, and porpoises. Seabird species composition was a mixture of species with boreal and southern affinities. Mean monthly seabird density ranged from 7.8 to 38.2 birds km^{-2}, and biomass density ranged from 3.8 to 27.3 kg km^{-2}. Abundance was seasonal in central and northern California waters with populations of migrating visitors outnumbering residents during all seasons. Birds sighted that were typical of boreal areas were auklets, fulmars, murres, and several species of gulls. Southern species appearing during late summer and fall were represented by the brown pelican and several species of petrels, shearwaters, and terns.

Total population estimate for the five pinniped species (California sea lion, harbor seal, Northern elephant seal, Northern fur seal, and Steller sea lion) occurring in the study area was approximately 50,000. Peak numbers were sighted in fall and spring. The California sea lion was the most abundant pinniped observed; overall mean density at sea was 0.21 animals km^{-2}. The Northern fur seals, found mostly in offshore waters (greater than 2,000 m water depths), exhibited densities of 0.19 animals km^{-2}. Approximately 62% of the sea otter population was sighted along the coast from Point Sur to Morro Bay and another 24% were observed from Point Sur to Monterey Bay. Sea otter populations exhibited some shifts in distribution during the three-year study period. Mean cetacean populations vary from 76,000 animals in spring to 152,000 animals in autumn. Cetaceans were most abundant during autumn months, with a mean cetacean density of 1.08 animals km^{-2}. Five porpoise species accounted for 95% of all cetaceans recorded. Ranked in order of decreasing abundance, these were Pacific white-sided dolphin, Northern right whale dolphin, Risso's dolphin, Dall's porpoise, and harbor porpoise. Baleen whales occurred within the study area primarily during seasonal migrations; in particular, most of the world population of approximately 17,000 California gray whales traverse the study area twice annually during seasonal migrations.

Twenty-nine leatherback sea turtles were recorded, mostly during periods of maximum water temperature (late summer and autumn) and between 9 and 185 km offshore.

STUDY PRODUCT(S): Dohl, T. P., M. L. Bonnell, R. C. Guess, and K. T. Briggs. 1983. Marine Mammals and Seabirds of Central and Northern California, 1980-1983: Executive Summary. A final report by The Center for Coastal Marine Studies, University of California, Santa Cruz for the U.S. Department of the Interior, Minerals Management Service Pacific OCS Office, Los Angeles, CA. NTIS No. PB85183820. Contract No. 14-12-0001-29090. 29 pp.

Dohl, T. P., M. L. Bonnell, R. C. Guess, and K. T. Briggs. 1983. Marine Mammals and Seabirds of Central and Northern California, 1980-1983: Synthesis of Findings. A final report by The Center for Coastal Marine Studies, University of California, Santa Cruz for the U.S. Department of the Interior, Minerals Management Service Pacific OCS Office, Los Angeles, CA. NTIS No. PB85183838. Contract No. 14-12-0001-29090. 247 pp.

Dohl, T. P., M. L. Bonnell, R. C. Guess, and K. T. Briggs. 1983. Marine Mammals and Seabirds of Central and Northern California, 1980-1983: Status, Abundance, and Distribution. A final report by The Center for Coastal Marine Studies, University of California, Santa Cruz for the U.S. Department of the Interior, Minerals Management Service Pacific OCS Office, Los Angeles, CA. NTIS No. PB85183846. Contract No. 14-12-0001-29090. 246 pp.

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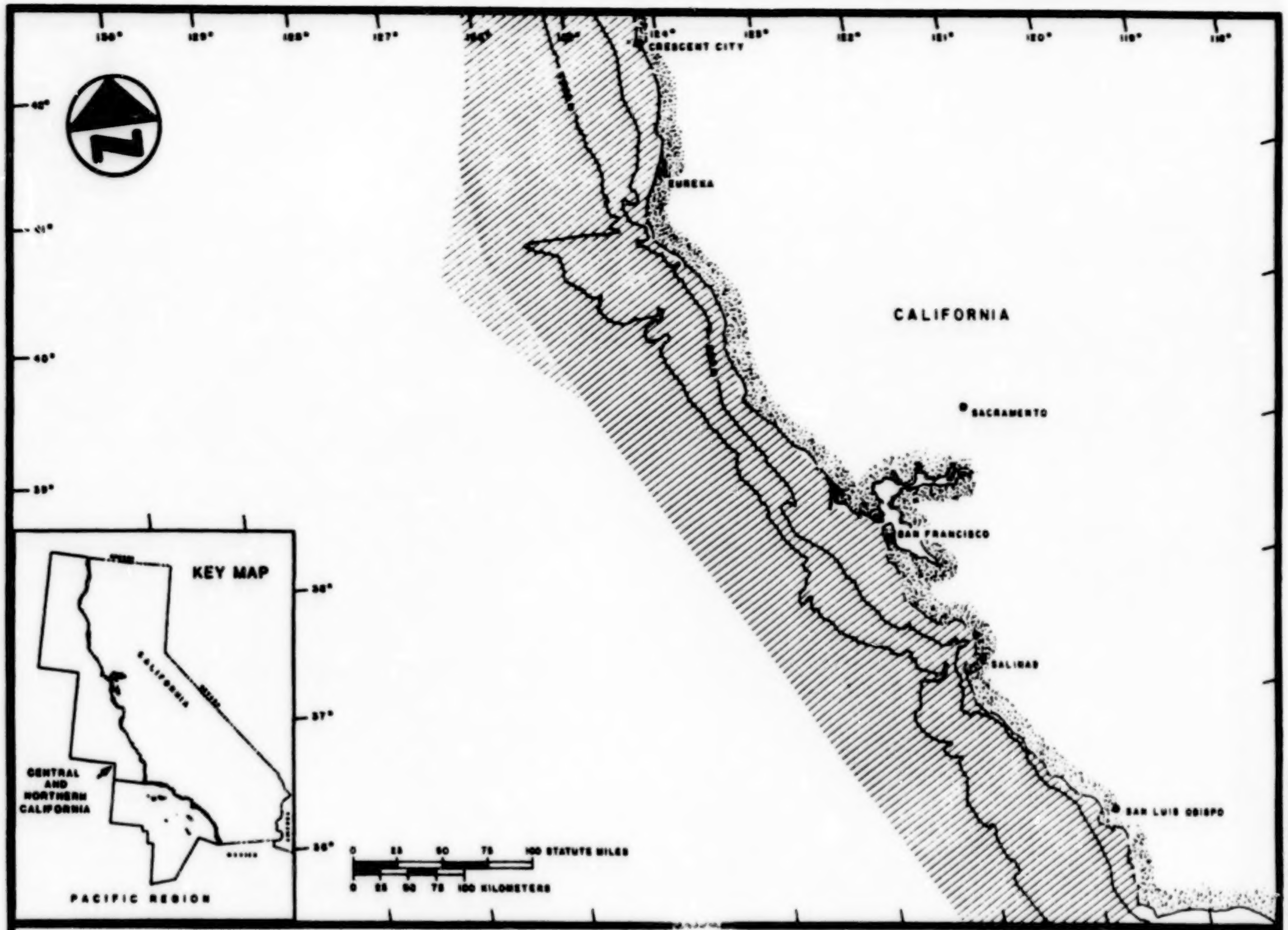

AREA SURVEYED DURING THE MARINE MAMMAL AND SEABIRDS OF CENTRAL AND NORTHERN CALIFORNIA STUDY, 1980 TO 1983.

ACCESS NUMBER:29090

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ACCESS NUMBER: **29104**

STUDY TITLE: Oil Spill Risk Assessment of Coastal and Marine Habitats in Central and Northern California.

REPORT TITLE: Central and Northern California Coastal Marine Habitats: Oil Residence and Biological Sensitivity Indices.

CONTRACT NUMBER(S): BLM: CT0-73; MMS: 14-12-0001-29104.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Central and Northern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1980.

COMPLETION DATE OF REPORT: November 1982.

COST(S): FY 1980: $481,659; CUMULATIVE PROJECT COST: $481,659.

PROJECT MANAGER(S): K. Macdonald.

AFFILIATION: Woodward-Clyde Consultants.

ADDRESS: 600 Montgomery Street, San Francisco, California 94111.

PRINCIPAL INVESTIGATOR(S)*: C. Foget, J. Harper, E. Owens, G. Robilliard, T. Winfield.

KEY WORDS: Central and Northern California; biology; geology; oil spill; risk assessment; coastal zone; intertidal; subtidal; aerial photography; videotapes; faunal zones; abundance; seasonality; oil residence; macrophytes; birds; marine mammals; vulnerability; recovery; maps.

BACKGROUND: Within the past decade, numerous indices have been developed as a means of representing the potential effect of oil on biological, physical, or human resources, or some combination of these. To be realistic and practical in its use by decisionmakers and environmental managers, as well as others, any oil spill sensitivity index must be flexible enough to account for temporal and spatial biotic variability. The lack of an index tailored to the unique physical environment and biological resources of the Central and Northern California coastal region prompted this study effort.

OBJECTIVES: (1) To prepare both geological and biological oil spill vulnerability analysis of Central and Northern California nearshore marine and coastal habitats; and (2) To characterize the surficial geology and the rocky intertidal biotic assemblages.

DESCRIPTION: Three aerial surveys of the study area were conducted to characterize the physical (i.e., geological) and biological components of the shore zone between Pt. Conception and the California-Oregon border. Videotape recordings (VTR) of the area were conducted simultaneously (during periods of spring low tides) in February (using fixed-wing aircraft), March, and July 1981. The latter two surveys were completed using low-altitude helicopter overflights. While in flight, a continuous descriptive commentary was provided by a geologist and a biologist to coincide with features being recorded on the VTR. Select biological or geological features of interest were also photographed using 35-mm color and infrared slide film. Ground-truthing surveys were completed (April and June-July 1971) to verify the shoreline biological classification developed from the VTR survey(s), to obtain data on beach profiles, and to obtain more detailed data on the occurrence and relative abundance of intertidal biota. A total of 97 primary sites (47 in Central California, 50 in Northern California) and 54 secondary sites were visited. All stations were selected to represent major shoreline types within larger coastal segments. Geological/oceanographic field observations included wind speed and direction, wave height and angle of approach, breaker type, sediment size characteristics, beach bearing strength, and an intertidal across-shore profile. Biological documentation and sampling was completed only at rocky intertidal stations. Photodocumentation of major associations was conducted with 35-mm color and infrared slide film.

SIGNIFICANT CONCLUSIONS: The characteristics of the shore-zone of Central and Northern California were identified and described for: (1) the exposed "outer" coast; and (2) the entire coast, including the shoreline lengths of estuaries and embayments. Five primary outer coast shore-zone types were identified, the most common of which was a combination of rock and beach. Considering the physical attributes of the coast, an index was developed to characterize the residence potential of spilled oil. For the exposed outer coast only, 3% of the study areas was deemed of primary concern. When estuaries or embayment shorelines were included, this figure increased to 42% due to the low wave energy of these areas. Utilizing a similar index developed to characterize the susceptibility of intertidal and subtidal communities to oil, it was concluded that approximately 31% of the outer coast was of primary concern with respect to biological sensitivity. When the entire coast was evaluated, this figure increased to 60%.

STUDY RESULTS: The physical shore-zone character of the study area was summarized for both the "outer" exposed coast (excluding estuaries and embayments; 1,186 km) and for the entire coastline (2,064 km). Shore zone types occurring on the outer coasts included a composite of beaches and rocky substrate (47%), solitary sand beaches (39%), and distinctive rocky substrates (<10%). Realizing that the persistence of oil contacting a shoreline segment (following a spill) is a function of the physical environment and the nature of the deposited oil, an Oil Residence Index (ORI) was developed. Three ORI categories were defined as follows: (1) Primary concern--areas characterized as sheltered environments with low wave energy levels; stranded oil is expected to remain in these areas for more than a year; (2) Secondary concern--areas characterized as exposed coasts (with seasonal beaches) with fetch greater than 10 km; oil stranded within the zone of normal wave action would remain for several months if it were buried by sediment; if unburied, removal would occur within several days to several weeks; and (3) Tertiary concern--areas characterized as exposed coasts with high wave energy levels and fetch greater than 10 km; oil stranded within the zone of normal wave action would remain for only a few days to a few weeks. In terms of the exposed outer coast shoreline, approximately 3% was considered to be of primary concern, while 30% was considered to be of secondary concern. The areas identified as being of secondary concern, most of which were sandy beaches, were also estimated to have a seasonally variable oil residence period. During winter erosion months, oil residence time could range from days to weeks; during accretion periods, oil residence time would be more extensive. The remaining sections of the exposed outer coast (67%) were identified as being of tertiary concern, where oil is likely to be removed within days to weeks due to high wave energy levels. When the total shoreline lengths of the estuaries and embayments were included, the relative frequency of sensitivities was altered significantly. Approximately 42% of the entire California coastline was considered to be of primary concern due to the extremely low wave energy levels characteristic of these protected shores. For the entire coast, 19% of the shoreline was classified as of secondary concern, while an additional 39% was identified as being of tertiary concern.

The intertidal zonation patterns of rocky substrates were found to be generally similar along the entire Central and Northern California coast for areas of similar wave exposure.

ACCESS NUMBER: **29104**

Distribution of all algal species, the most conspicuous element of the intertidal biota, was variable within the study area. Many of the numerically dominant species (e.g., Endocladia nuricata, Fucus distichus, Gigartina spp., Postelsia palmaeformis, Iridaea spp., and Laminaria spp.) occurred throughout the study area. Offshore kelp beds along the coast were numerically dominated by the annual Nereocystis luetkeana or the perennial Macrocystis pyrifera. Occasional subtidal populations of Egregia menziesii were noted. Two species of macroinvertebrates, consisting of beds of the mussel Mytilus californianus and the gooseneck barnacle Pollicipes polymerus, were conspicuous. Mussel beds were most extensive, continuous, and dense along the broad, exposed mid-tide platforms of the California coast. P. polymerus was commonly noted in association with the mussel beds or in large solitary pockets. Pisaster ochraceus was also conspicuous but patchy in its distribution at the low to mid-tide level. In addition to the characterization of intertidal areas, the study also identified a portion of the 90 species of marine birds and 8 species of marine mammals which occur within the study area.

The Biological Sensitivity Index (BSI) was developed as a guideline for identifying which section of the coast may have a high level of biological sensitivity to oil spills. The levels of concern of the BSI were defined on the basis of the potential effect an oil spill could have upon a target population or biological community. Vulnerability was defined as the likelihood that some portion of the biotic resource of concern would come into contact with oil, while sensitivity was defined as the response of the biotic resource to contact with oil. Areas of primary concern were those where a major change in distribution, size, structure, and/or function of the affected biotic resource would be expected; recovery from these changes was expected to require several years to decades. Areas of secondary or tertiary concern were those where either moderate or minimal changes in these characteristics (noted above) would be expected; recovery times for these two levels of concern were several years or several months to several years, respectively. Approximately 31% (373 km) of the outer coast was classified as being of primary concern with respect to biological sensitivity. Ninety-two percent of the coast classified as primary was contained within the range of the southern sea otter. Only 1% (16 km) of the outer coast was classified as being of secondary concern, with the remainder listed as tertiary. When the entire coast was evaluated, 60% was identified as being of primary concern, including all major embayments, estuaries, and lagoons except the Pajaro River. Comparisons between indices (ORI, BSI) were also made, allowing for a separate consideration of potential biological sensitivity and potential oil residence time to oil spills.

STUDY PRODUCT(S): Woodward-Clyde Consultants. 1982. Central and Northern California Coastal Marine Habitats: Oil Residence and Biological Sensitivity Indices. A final report for the U.S. Department of the Interior, Minerals Management Service Pacific OCS Office, Los Angeles, CA. 2 Volumes. Contract No. AA851-CT0-73.

Appendices to the Final Report include original geological and biological field data sheets (4 volumes), a videotape slide manual, 104 20-min aerial videotapes, and 15 volumes of 35-mm slides. Map sets included: 95 maps of detailed biological and physical characteristics (1:24,000 scale); 8 maps of general characteristics (1:250,000 scale); and 1 map of the regional overview of ORI and BSI (1:100,000 scale). Vol. I and II were summarized in POCS Tech. Paper Nos. 83-5 and 83-6.

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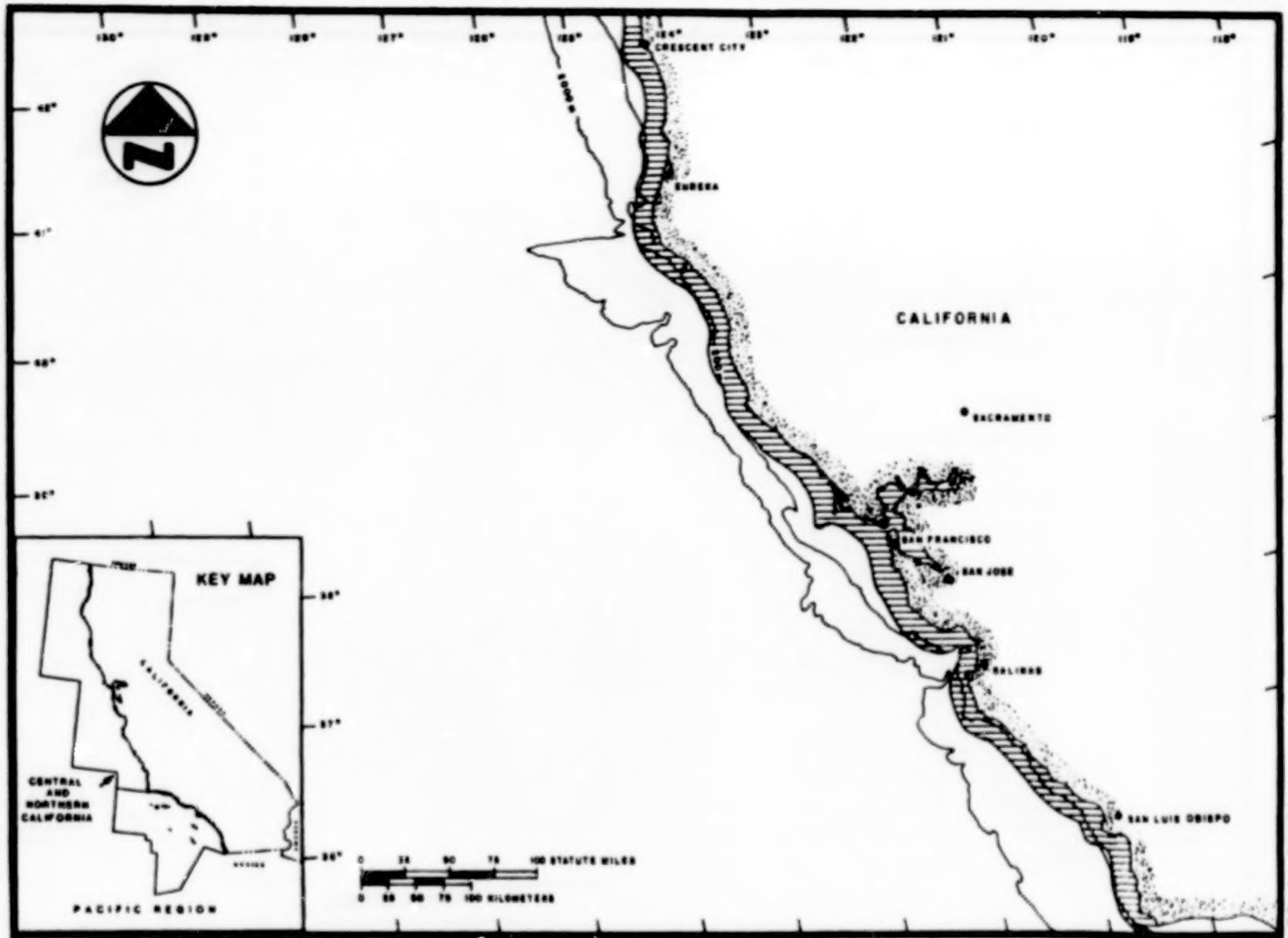

EXPOSED COASTLINE AND EMBAYMENTS SURVEYED AERIALLY DURING THE CENTRAL AND NORTHERN CALIFORNIA COASTAL MARINE HABITATS: OIL RESIDENCE AND BIOLOGICAL SENSITIVITY INDICES STUDY.

ACCESS NUMBER 29104

ACCESS NUMBER: **29104**

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ACCESS NUMBER: **30032**

STUDY TITLE: Assessment of Long-Term Changes in the Biological Communities in the Santa Maria Basin and Western Santa Barbara Channel (Year I).

REPORT TITLE: Assessment of Long-Term Changes in Biological Communities of the Santa Maria Basin and Western Santa Barbara Channel - Phase I. Vol. I, Executive Summary; Vol. II, Synthesis of Findings.

CONTRACT NUMBER(S): MMS: 14-12-0001-30032.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Central and Northern California; Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1983; 1984; 1985.

COMPLETION DATE OF REPORT: February 1986.

COST(S): FY 1983: $500,000; FY 1984: $908,472; FY 1985: $100,093; CUMULATIVE PROJECT COST: $1,508,565.

PROJECT MANAGER(S): A. Lissner, R. Shokes.

AFFILIATION: Science Applications International Corporation.

ADDRESS: 476 Prospect Street, La Jolla, California 92037.

PRINCIPAL INVESTIGATOR(S)*: W. Anikouchine, B. Bernstein, D. Cadien, R. Cimberg, R. Kanter, T. Kauwling, A. Lissner, J. Payne, C. Phillips, R. Shokes, R. Sims, R. Smith.

KEY WORDS: Central and Northern California; Southern California; Point Estero; Santa Barbara Channel; Santa Maria Basin; biology; benthos; habitat; community; sediment; hydrocarbons; trace metals; hard-bottom; photographs; grain size; gas chromatography; submersible; videotapes; observations; benthic photographs; epifauna; infauna; photographimetric technique; maps; shelf; slope.

BACKGROUND: The Santa Maria Basin and Western Santa Barbara Channel of Southern California are slated for extensive oil and gas development. The U.S. Department of the Interior is responding to this anticipated offshore activity by sponsoring a three-phase program designed to monitor long-term changes in the benthic environment related to operational or accidental oil and gas related inputs. This report contains the first-phase results regarding background levels of sediment hydrocarbon and trace metal concentrations and recommendations for future monitoring sites.

OBJECTIVES: (1) To identify and map benthic habitats and biological assemblages; (2) To describe any new benthic species; (3) To characterize existing sediment hydrocarbon and trace metal levels; and (4) To identify candidate sites and species for future long-term monitoring studies.

DESCRIPTION: Soft-bottom and hard-bottom surveys were conducted from November 1983 to January 1985. Soft-bottom surveys included sampling at 107 stations located along 16 transects. Sediments were collected using a Teflon and stainless steel coated 0.1-m^2 box corer and a 0.1 m^2 Van Veen grab sampler. One to three replicates were taken at each station (nine replicates were taken at one station to assess within core variability). Color 35-mm photographs were taken of the surface and sides of the core. Samples for chemical, geological, and physical analysis were extracted from each core sample. Trace metal samples were collected using Teflon utensils and frozen. Hydrocarbon samples were collected using hexane washed glass jars with Teflon lids. A Plexiglas tube was used to sample for sediment grain size.

Sediment cohesiveness was measured using a torsional vane shear device. The remainder of the sample was sifted through a high volume, low pressure, tiered, sieving device with 5.0-mm, 1.0-mm, and 0.5-mm openings. All specimens were relaxed in magnesium sulfate then preserved in formalin.

In the laboratory, infaunal samples were sorted into annelids, crustaceans, echinoderms, mollusks, and other groups. Organisms within each group were wet weighed and counted. Selected species were measured. Samples for hydrocarbon analysis were fractionated into polar, saturated, and aromatic compounds, then analyzed using a gas chromatograph with flame ionization detector. The data obtained were used to determine values for the following parameters: total hydrocarbons, total aromatics, total alkanes and saturates, total unresolved components, pristine/phytane ratio, pristane/nC^{17} ratio, phytane/nC^{18} ratio, odd alkanes/even alkanes ratio, and unresolved/resolved complex ratio. Barium and chromium from the sediments were detected using instrumental neutron activation analyses. Total organic carbon in sediments was estimated with a carbon analyzer. Grain size analyses were performed by settling tube and reported in phi units. Hard-bottom surveys were conducted at selected locations of the Santa Barbara Channel and Santa Maria Basin. Manned submersible dives were made along 23 transects representing 15 stations extending from near Gaviota to Pt. Estero, California. Survey depths ranged from 60 to 240 m with an average of 100 to 130 m. Data collected from these areas consisted of color videotapes, direct observations, and 35-mm still photographs. Still photographs were analyzed for species composition, percent epifaunal cover, substrate type, percent sediment cover, and relief. Only slides where distance and area covered could be accurately estimated were used for quantitative estimations. Data values for measured variables (grain size, trace metals, hydrocarbons, and total organic carbon) were plotted on a computer-generated map of the study area. Statistical analyses of soft-bottom and hard-bottom data consisted of ordination, cluster, and discriminant analyses. Ecological distance measure was employed as a multivariate measure of biological change. Power tests were used to determine sample sizes required to detect a 50% change from observed background levels.

SIGNIFICANT CONCLUSIONS: Soft-bottom communities were distributed primarily by depth b some north-south trends were evident. The numerically dominant organisms were polychaete worms, followed by echinoderms. Comparisons with the literature indicate little change in soft-bottom community composition over the last six years on the shelf; slope communities exhibited some changes. Submersible observations revealed three hard-bottom assemblages and one soft-bottom assemblage. Hard-bottom communities were dependent on depth and available substrate. Sessile invertebrates such as anemones, cup corals, and hydroids were considered most vulnerable to impacts from drilling-related discharges. Trace metal levels in sediments were associated with proximity to input sources, both anthropogenic or natural. Potential sources of hydrocarbons were seeps, erosion of oil-bearing shales, shipping losses, tanker operations, atmospheric deposition, oil and gas operations, discharges of municipal and industrial waste waters, and deposition of allochthonous (terrestrial plants) and autochthonous biogenic sources. Certain hydrocarbon concentrations in bottom sediments were correlated with fine bottom sediments.

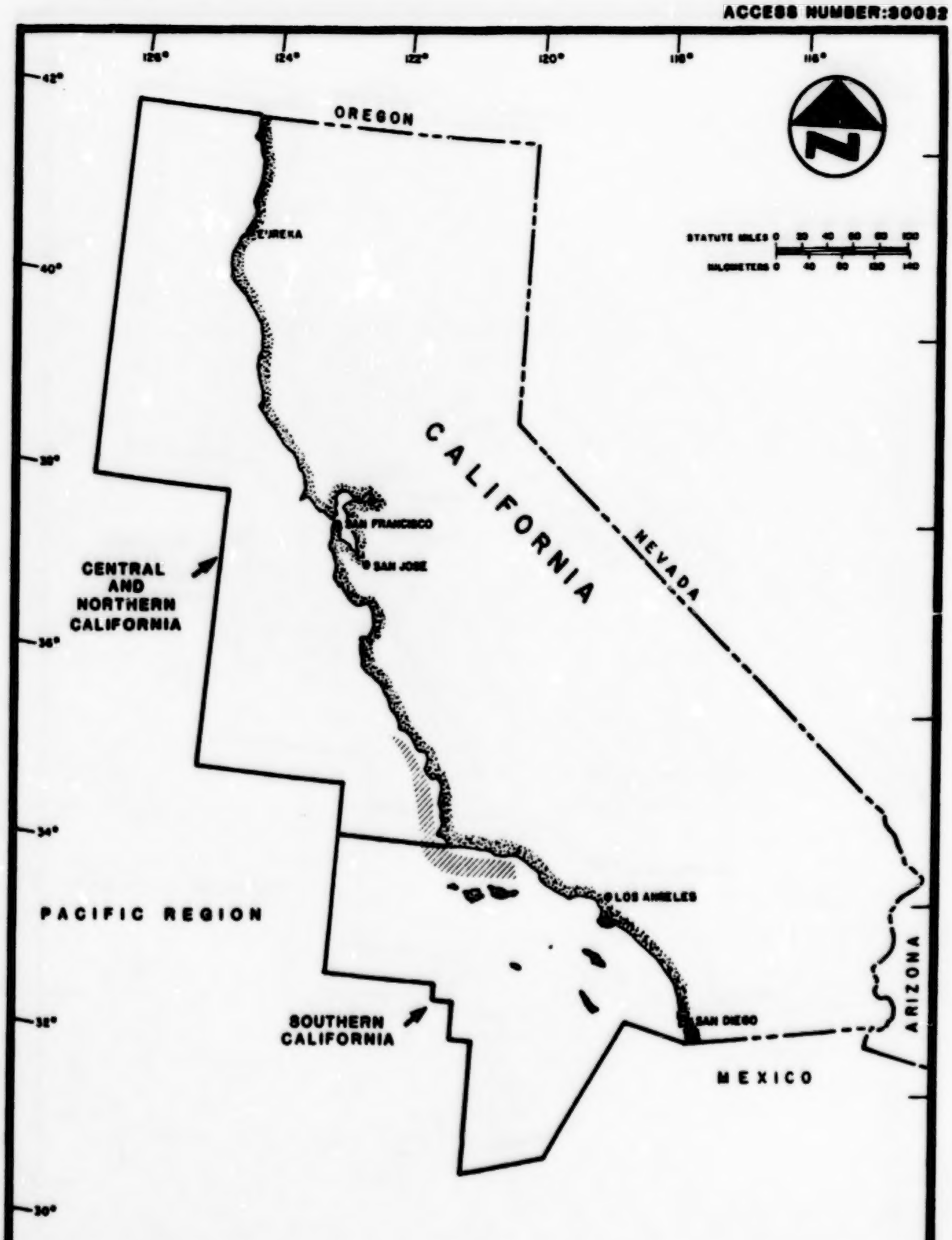
STUDY RESULTS: The soft-bottom assemblage of the inner shelf was numerically dominated by polychaetes, while heart urchins dominated biomass values. Soft-bottom biological assemblages of the outer shelf were numerically dominated by ophiuroids and other echinoderms. Of the 996 soft-bottom taxa collected, 20% were previously undescribed. The commercially important spot prawn occurred in the study area but was not taken in appreciable quantities. Clustering discerned six major and five secondary site groups, mostly separated by water depth. At shelf and mid-slope depths, the number of species and individuals per sample decreased with increasing depth. Hard-bottom features were recorded on 17 of 23 transects; only five of the transects exhibited outcrop areas comprising >90% of the transect. Sediment cover was extensive on most of the transects. Substrate relief was generally low (0 to 1 m) over most transect areas. Some areas exhibited medium to high relief. The occurrence and development of hard-bottom animal communities depended on substrate relief and availability. Numerically dominant invertebrate taxa identified from photographs included echinoderms (33 taxa) and coelenterates (31 taxa). Three hard-bottom assemblages were identified: a generalist assemblage characterized by anemones, crinoids, cup corals, and sea stars occurring throughout the range of depths encountered during the study; a low/medium relief assemblage characterized by ophiuroids, brachiopods, and anemones typically occurring in lower relief areas; and a high to medium relief assemblage characterized by few taxa including anemones, corals, and other generalist taxa.

Three main sediment types were recognized in the study area: Santa Lucia Bank sediment comprised of oxidized mud containing phosphorite grains and medium to fine grained sand with low organic content; continental shelf sediment in depths less than 120 m consisting of mud with fine sand, low clay content, high sand content, and low organic carbon content; and continental slope sediment occurring at depths below 120 m characterized by olive green mud with high clay and silt content, low sand content, and high organic carbon content. Ranges of sediment concentration of barium and chromium were 162 to 1,180 ug g dry wt^{-1} and 66 to 415 ug g dry wt^{-1}, respectively. Total sediment hydrocarbon levels ranged from 1.2 to 166 ug g dry wt^{-1}. Aromatic hydrocarbons in sediments ranged from 0.38 ug g dry wt^{-1} to 78 ug g dry wt^{-1}. Relatively higher levels occurred at stations in the nearshore areas south of Pt. Conception, within the Santa Barbara Basin, in the Arguello submarine canyon, and in the sea valley east of Santa Lucia Bank. These stations are apparently near natural petroleum seeps. Total organic carbon in sediments ranged from 0.36% to 3.4%.

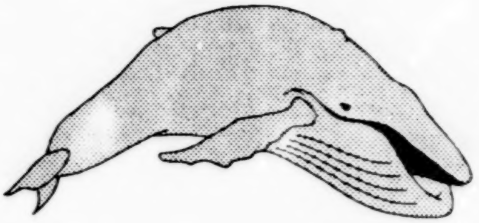
STUDY PRODUCT(S): Lissner, A., C. Phillips, D. Cadien, R. Smith, B. Bernstein, R. Cimberg, T. Kauwling, and W. Anikouchine. 1986. Assessment of Long-Term Changes in Biological Communities of the Santa Maria Basin and Western Santa Barbara Channel - Phase I. Vol. I, Executive Summary. A final report by Science Applications International Corporation for the U.S. Department of the Interior, Minerals Management Service Pacific OCS Region, Los Angeles, CA. NTIS No. PB86-240363. Contract No. 14-12-0001-30032. 33 pp.

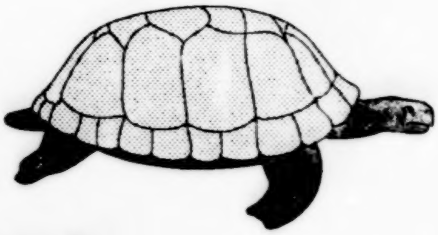
Lissner, A., C. Phillips, D. Cadien, R. Smith, B. Bernstein, R. Cimberg, T. Kauwling, and W. Anikouchine. 1986. Assessment of Long-Term Changes in Biological Communities of the Santa Maria Basin and Western Santa Barbara Channel - Phase I. Vol. II, Synthesis of Findings. A final report by Science Applications International Corporation for the U.S. Department of the Interior, Minerals Management Service Pacific OCS Region, Los Angeles, CA. NTIS No. PB86-240371. Contract No. 14-12-0001-30032. 471 pp.

*P.I.'s affiliation may be different than that listed for Project Manager(s).



STUDY AREA FOR ASSESSMENT OF LONG-TERM CHANGES IN BIOLOGICAL COMMUNITIES OF THE SANTA MARIA BASIN AND WESTERN SANTA BARBARA CHANNEL.





Endangered Species

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ACCESS NUMBER: **30023**

STUDY TITLE: Synthesis of Available Population Information on California Sea Otters.

REPORT TITLE: Summary of Available Population Information on California Sea Otters.

CONTRACT NUMBER(S): MMS: 14-12-0001-30023.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Central and Northern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1983.

COMPLETION DATE OF REPORT: August 1983.

COST(S): FY 1983: $6,160; CUMULATIVE PROJECT COST: $6,160.

PROJECT MANAGER(S): J. Estes.

AFFILIATION: U.S. Fish and Wildlife Service, Denver Wildlife Research Center.

ADDRESS: The Center for Coastal Marine Studies, University of California, Santa Cruz, Santa Cruz, California 95064.

PRINCIPAL INVESTIGATOR(S)*: J. Estes, R. Jameson.

KEY WORDS: Central and Northern California; biology; historical review; sea otter; Enhydra; threatened species; population; range; distribution; seasonality; migration; tagging; radiotelemetry.

BACKGROUND: Since 1969, a variety of studies have been conducted along the Central California coast to document the population size and individual behavior patterns of the sea otter (Enhydra lutris). As a Federally listed threatened species, the continued existence of the population is of primary concern to Federal, State, and local regulatory agencies. Although several tagging efforts [U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Game (CDFG)] are continuing, no comprehensive review of previous surveys and marking/tagging studies has been made in recent years.

OBJECTIVES: (1) To provide the Minerals Management Service and the general public with a thorough and comprehensive review of previously conducted sea otter surveys and marking studies, and where possible, to briefly summarize study results.

DESCRIPTION: The methods of analysis employed, data collected, and conclusions drawn from survey work conducted to date over the entire population range of the sea otter were summarized. An identification and summary of the marking and tagging studies completed to date was also presented.

SIGNIFICANT CONCLUSIONS: A review of data collected through 1982 using several population censusing techniques indicated that the California sea otter population was relatively stable in size and geographic range during the previous 10- to 15-year period. Earlier estimates had placed the population size at 1,500 otters; estimates compiled in 1982 revised that figure downward to approximately 1,300 individuals. Females, pups, and adult males were concentrated in coastal nearshore areas between Monterey and Pt. Estero, while areas to the north and south contained nonreproductive males on a seasonal basis. Censusing and tagging studies conducted between 1969 and 1972 were resumed in 1977.

STUDY RESULTS: Two types of population surveys were identified. The first approach estimated the geographical range and total population size through a combination of aerial and shore-based counts. Due to variations in sampling methods, valid comparisons among surveys could not be made. Prior to 1982, most surveys were conducted by CDFG personnel. Results from surveys prior to 1976 have been summarized in CDFG publications. Studies completed between 1977 and 1980 were also summarized by the USFWS. In all of these studies, the geographical range of the sea otter in California waters was determined directly from aerial or shore-based observations. Population size estimates were made using the ratio estimator method, where sea otters are counted within small areas of coastline concurrently by aerial and shore-based observers, and the entire range of the population is censused by aerial observers. It was assumed that the shore-based observations were nearly perfect, whereas the aerial observations were missing some percentage of the population observed within the small coastline segments. The whole population estimate was then derived by multiplying the ground count to aerial count ratio by the aerial count of the entire population range. A second method of population surveying was the modified mark-recapture estimator, which utilizes aerial and ground counts. This method also required that observers (aerial and ground-based) mark the precise locations of their sightings concurrently on maps. The aerial counts were treated as marked animals, while the ground counts were considered as a resampling of the marked population; the number of these ground-based sightings, which were also seen from the air, represented resightings. This method and data from a 1976 survey effort were summarized by Geibel and Miller. A third method used to estimate population size utilized ground-based observers positioned along accessible segments of the coast, with the remaining coastline censused by aerial observers.

The second type of population surveying was an indexing effort in which the purpose was only to detect distribution and population size trends. The surveys did not provide data from which population size estimates could be generated. Periodic or occasional censusing of small segments of coast from shore or air was used to monitor changes in local abundance or density over time; these data sets were not summarized or analyzed. Aerial surveys of the entire population have also been made, but data collected were insufficient to draw conclusions regarding population trends.

Collective survey data indicated that the California sea otter population appears to have changed little in size during the past 10 to 15 years. A reevaluation of data indicated that the population size was approximately 1,500 animals in the mid-1970s. A total of 1,300 individuals were estimated to comprise the 1983 population. The distribution of the population also appeared to have changed little since 1976. Noted differences included the establishment of a male group near Santa Cruz in 1977 and the decline in total numbers of individuals south of Cayocos Point (attributed to a seasonal shift of males northward into reproductive areas). Some range expansion to the south was also documented, but numbers south of Pismo Beach remained small. Seasonal shifts in distribution were attributed to males moving into reproductive areas during the summer-fall period and returning to the periphery of the range during the winter-spring period. Smaller distribution changes were also recorded and were attributed to seasonal changes in kelp bed distribution. The population within the section of coastline between Monterey and Pt. Estero was comprised primarily of females, pups, and adult males. Areas to the north of Monterey and south of Pt. Estero contained primarily nonreproductive males, except during the winter-spring period when the adult males returned.

A small group of breeding females exist between Pt. Buchon and Port San Luis, and the group has remained unchanged since 1976 and represents the only growing subpopulation of reproducing females.

Tagging studies of individual sea otters were first started in 1969 and continued until December 1972 under the direction of the CDFG personnel. The CDFG resumed its tagging efforts in 1977 and as of August 1983, had tagged 239 otters. The USFWS began its own tagging study in 1978 and, as of August 1983, had tagged 124 otters.

The University of Minnesota also studied sea otter activity and movements using radiotelemetry during the Falls of 1978 and 1979. Results of the early CDFG tagging studies indicated that otters captured and translocated 72 km to another otter area returned to the place of capture. Visual observations and radiotelemetry results from 1975 indicated that the home ranges of adult females (80 ha) exceeded that of adult territorial males (35 ha) and nonterritorial adult males (44 ha). More recent data, collected during the Falls of 1978 and 1979, indicated higher home range values for resident females (680 ha) and males (460 ha); nonresident males had much larger ranges. As of late 1983, no analyses had been completed on tagged otter recoveries.

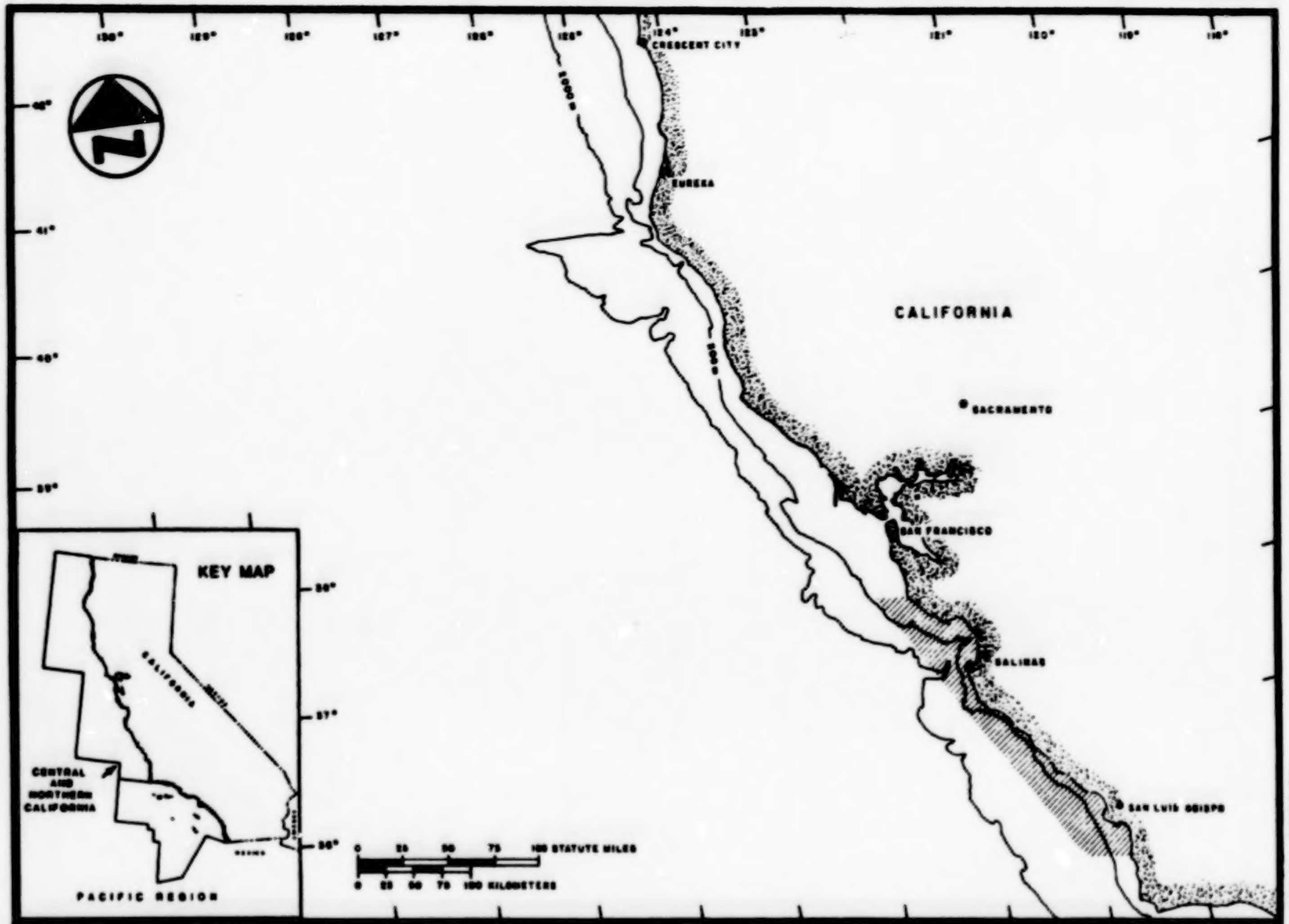
Researchers have noted that some females pup annually, wean their pups at 3.5 to 8 months, and have a gestation period of 4 to 6 months. Results from other studies which sampled a higher number of animals indicated a pup dependency period and gestation period of about six months each.

Observations of otter behavior indicated that there was no correlation between otter activity, tidal rhythyms, or daylight. Researchers have noted that sea otters spend about 50% of their time active.

Shore-based counts of otters have also been conducted routinely along small segments of the California coast, including weekly surveys of the northern peripheral group since 1980 and seasonal surveys of the population between Pt. Buchon and Port San Luis since 1973.

STUDY PRODUCT(S): Estes, J. A. and R. J. Jameson. 1983. Summary of Available Population Information on California Sea Otters. A final report by the U.S. Fish and Wildlife Service for the U.S. Department of the Interior, Minerals Management Service Pacific OCS Office, Los Angeles, CA. Contract No. 14-12-0001-30023. POCS Tech. Paper No. 83-11. 29 pp.

*P.I.'s affiliation may be different than that listed for Project Manager(s).



COASTAL AREA STUDIES FOR SEA OTTER (ENHYDRA LUTRIS) SURVEYS.

ACCESS NUMBER:30023

ACCESS NUMBER: **30157**

STUDY TITLE: Sea Otter Oil Spill Mitigation Study.

REPORT TITLE: Sea Otter Oil Spill Mitigation Study.

CONTRACT NUMBER(S): MMS:14-12-0001-30157.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California; Central and Northern California; Gulf of Alaska; Kodiak; Cook Inlet; Shumagin; North Aleutian Basin; St. George Basin; St. Matthew Hall; Navarin Basin; Norton Basin; Hope Basin; Barrow Arch; Diapir Field.

FISCAL YEAR(S) OF PROJECT FUNDING: 1984; 1985.

COMPLETION DATE OF REPORT: May 1986.

COST(S): FY 1984: $463,247; FY 1985: $10,000; CUMULATIVE PROJECT COST: $473,247.

PROJECT MANAGER(S): R. Davis.

AFFILIATION: Hubbs Marine Research Institute.

ADDRESS: 1700 South Shores Road, San Diego, California 92109.

PRINCIPAL INVESTIGATOR(S)*: L. Cornell, R. Pastorak, J. Thomas, T. Williams.

KEY WORDS: Southern California; Central and Northern California; Gulf of Alaska; Kodiak; Cook Inlet; Shumagin; North Aleutian Basin; St. George Basin; St. Matthew Hall; Navarin Basin; Norton Basin; Hope Basin; Barrow Arch; Diapir Field; endangered species; sea otter; Enhydra; oil spill; mitigation; dispersant; captures; cleaning; rehabilitation; radiotelemetry; mortality; behavior; thermal conductance.

BACKGROUND: The sea otter (Enhydra lutris) inhabits intertidal and shallow subtidal areas along portions of the California, Canadian, and Alaska coasts. Sea otters rely upon an air layer trapped in the dense fur for thermal insulation. Crude oil contamination of fur eliminates the air layer and reduces its thermal insulation. Without adequate insulation in cool water, sea otters are subject to hypothermia and death. The major emphasis of this study was development of a safe and effective procedure to clean and rehabilitate oiled sea otters.

OBJECTIVES: (1) To analyze the effectiveness of existing capture, transport, cleaning, and rehabilitation methods and to develop new methods to reduce the impact of an accidental oil spill to California sea otters; (2) To investigate whether or not a systematic difference in thermal conductivity exists between California and Alaska sea otter pelts; and (3) To survey and evaluate potential rehabilitation facilities along the west coast of the United States and Canada relative to requirements for cleaning and rehabilitating oiled sea otters.

DESCRIPTION: Sea otter capture methods were reviewed and recommendations made as to the most effective and practical methods for capturing sea otters. Methods were evaluated and recommendations made for transport cages, modes of transport, and temporary holding pens. Physical and chemical restraints of sea otters were discussed.

The degree to which thermal conductance was restored after cleaning oiled pelts was used to assess the effectiveness of various cleaning agents and procedures. The cleaning procedure was tested on Santa Barbara fresh crude oil, Santa Barbara 5-day weathered crude oil, and an oil/dispersant mixture. Once a cleaning procedure was developed using excised pelts, it was tested on live Alaska sea otters that had 20% of their surface area oiled with fresh crude. A discussion of sea otter anesthesia, surgical implantation of radio transmitters, and subsequent morbidity and mortality was provided. Morphological and insulatory parameters measured for Alaska and California sea otters included guard hair and underfur lengths. Rehabilitation of oiled and cleaned otters was discussed and recommendations provided for husbandry and veterinary care required while otters recover from oiling, capture, and cleaning stress. Seventeen potential sea otter rehabilitation sites along the west coast of the United States and Canada were surveyed. Data were presented for each site's facilities, equipment, available personnel, and response time. In addition, recommendations were made for the minimum requirements for cleaning and rehabilitating up to 60 wild sea otters. Information on capture, transport, restraint, cleaning, rehabilitation, and release of sea otters was summarized and recommendations were made for the development and implementation of an oil spill contingency plan.

SIGNIFICANT CONCLUSIONS: Present methods for handling and transport of sea otters are safe and reliable, although additional research could improve capture methods. Meperidine hydrochloride and diazepam are very effective chemical restraints for routine immobilization of oiled otters which require cleaning. Dawn dishwashing detergent with warm (40 C), pressurized water rinses was the most effective procedure for cleaning sea otter fur contaminated with oil and oil/dispersant mixtures. Oiled sea otters can be successfully cleaned and rehabilitated in one to two weeks using the procedure developed in this study. Close veterinary support is essential. Measurements showed no significant difference in the thermal conductance of pelts from Alaska or California sea otters. Minimum requirements for cleaning 60 oiled sea otters and a review of potential rehabilitation facilities were provided for development of a sea otter oil spill contingency plan.

STUDY RESULTS: Dip nets, diver-held traps, and modified gill nets (tangle nets) were the most effective methods of capturing sea otters. Sea otters can be safely transported by boat, land vehicle, or plane using existing cage specifications. Constant monitoring of the otters by animal care specialists is required to prevent hyperthermia or hypothermia. For complete physical restraint, use of a transport cage or modified blood collection cage in conjunction with a stuff bag is recommended. Chemical restraint of oiled sea otters is necessary before cleaning can be attempted. Combinations of meperidine hydrochloride and diazepam provided the safest, most reliable sedation.

Dawn (Proctor and Gamble) dishwashing liquid was the most effective cleaner of sea otter fur. Pretreatment of oiled pelts with a variety of solvents did not improve crude oil removal and is not recommended. Proper rinsing was the most important factor in returning the loft and water repellency of the fur. Efforts to replace natural oils in washed pelts by application of reconditioners were unsuccessful. The cleaning procedure developed in this study returned the insulation of oiled sea otter pelts to the original condition despite losses in natural oils from the fur.

After fresh Santa Barbara crude oil was applied to 20% of the surface area of live sea otters in a band (6-8 cm wide) around the chest, most otters showed similar changes in behavior: grooming increased from 35% to 61%, swimming increased from 10% to 17%, and resting decreased from 49% to 12% of the total activity time. Grooming activity worsened the effect of oiling by rubbing the oil deeper into the fur and spreading it to unoiled areas.

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Normal grooming after cleaning is essential to restoring the fur to its pre-oiled insulatory quality. Successful rehabilitation of oiled sea otters after cleaning requires proper husbandry and veterinary care. Special considerations during rehabilitation include adequate food intake to maintain body weight and to prevent shock and secondary disease.

Guard hair and underfur length measurements were taken on Alaska and California adult sea otter pelts. To examine differences in the insulatory quality of Alaska and California sea otter fur, thermal conductance of mounted pelt squares was measured. No significant differences were found for either hair length or insulatory properties.

A summary of sea otter housing facilities and available personnel, veterinary and husbandry support, and capture equipment for each rehabilitation site was provided. Minimum requirements for rehabilitating oiled sea otters include holding pools, water supply, food and freezer space, recovery area, cleaning equipment, transport cages, personnel, and husbandry and veterinary supplies.

Of the three potential rehabilitation sites that meet the minimum requirements for cleaning and rehabilitating oiled sea otters and are in geographical proximity to the sea otter range. only Diablo Canyon is dedicated solely to the rehabilitation of oiled sea otters. Morro Bay Aquarium and Monterey Bay Aquarium could assist in the efforts at Diablo Canyon should the latter site become overloaded with oiled otters.

STUDY PRODUCT(S): Hubbs Marine Research Institute. 1986. Sea Otter Oil Spill Mitigation Study. A final report for the U.S. Department of the Interior, Minerals Management Service Pacific OCS Region, Los Angeles, CA. MMS Report 86-0009. Contract No. 14-12-0001-30157. 221 pp.

*P.I.'s affiliation may be different than that listed for Project Manager(s).

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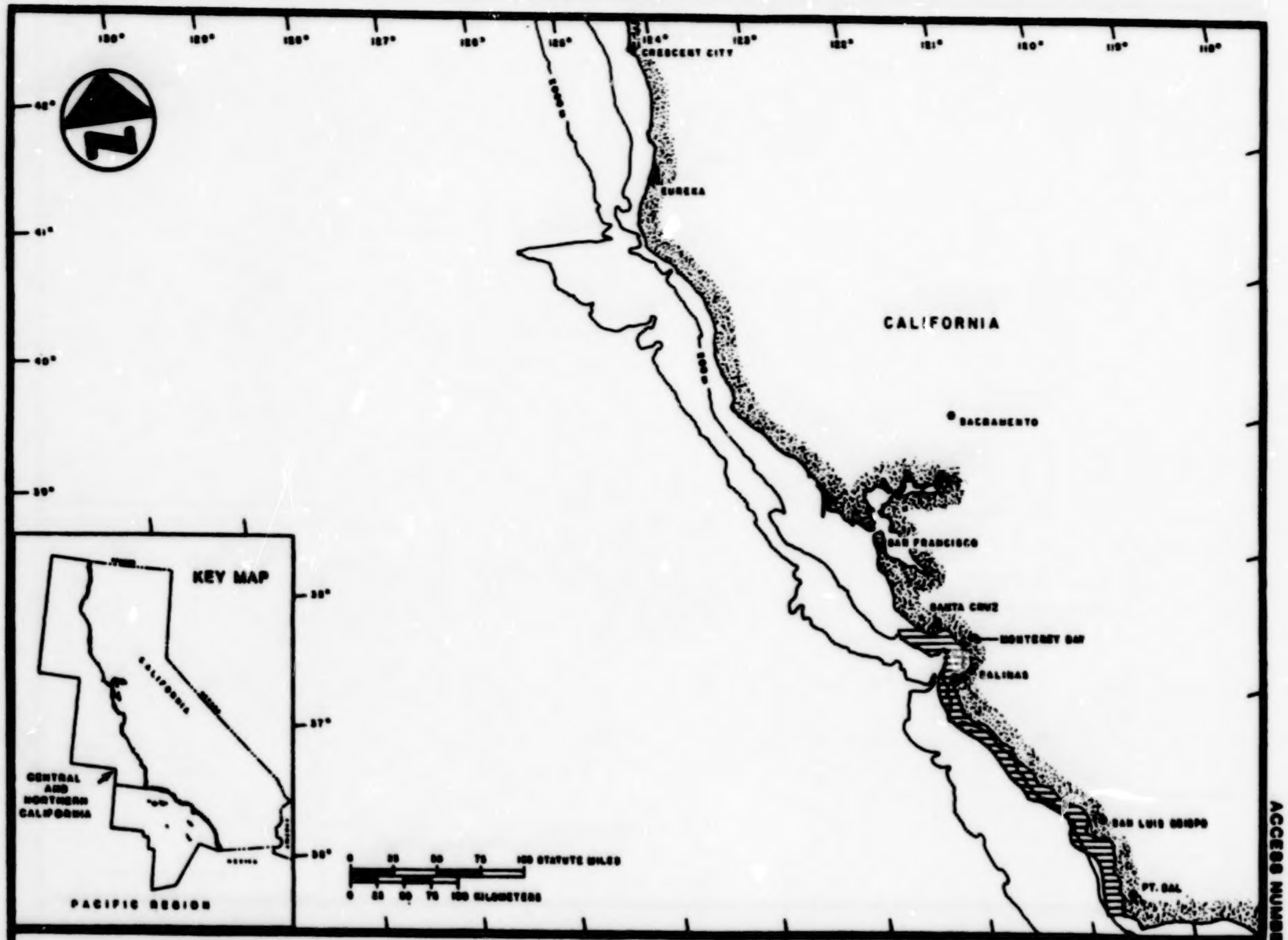

PRESENT (1986) ESTABLISHED RANGE OF THE SEA OTTER IN CALIFORNIA.

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Fates and Effects

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ACCESS NUMBER: **29102**

STUDY TITLE: California Seabird Oil Spill Behavior Study.

REPORT TITLE: Seabird-Oil Spill Behavior Study.

CONTRACT NUMBER(S): BLM: CT0-70; MMS: 14-12-0001-29102.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California; Central and Northern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1980.

COMPLETION DATE OF REPORT: April 1983.

COST(S): FY 1980: $496,294; CUMULATIVE PROJECT COST: $496,294.

PROJECT MANAGER(S): D. Varoujean.

AFFILIATION: Nero and Associates, Inc.

ADDRESS: 520 S.W. Sixth Avenue, Suite 1120, Portland, Oregon 97224.

PRINCIPAL INVESTIGATOR(S)*: B. Allen, D. Baltz, D. Power, D. Schroeder.

KEY WORDS: Southern California; Central and Northern California; fates and effects; seabirds; oil spill; behavior; literature review; mitigation; Santa Barbara Channel; abundance; photographs; videotapes.

BACKGROUND: Offshore drilling, oil transportation, and consequently, the probability of an oil spill is increasing in coastal U.S. waters. Documentation of the effects of oil on seabirds is needed so that sound managerial decisions can be made regarding petroleum industry activity in the coastal zone.

OBJECTIVES: (1) To collect and analyze existing literature dealing with seabird/oil encounters; (2) To collect observations of seabird reactions to oil slicks in the Santa Barbara Channel and at the site of a major oil spill to obtain detailed information on seabird/oil interactions; (3) To synthesize information gathered during the study; and (4) To provide recommendations on mitigation techniques and regulatory procedures.

DESCRIPTION: Literature was collected and an annotated bibliography on seabird/oil interactions was prepared. A review was made of literature having a specific bearing on the effects of oil on seabird behavior. In the Santa Barbara Channel off Coal Oil Point, 27 two-day field trips were conducted aboard survey vessels from November 1980 to January 1982. Aircraft were used, weather permitting, on each trip to locate a slick so that vessel personnel could be informed of its location and extent. While at anchor, observations were recorded on weather and sea conditions; type, location, and movement of oil slicks; and information regarding the seabird's species, gender, plumage, age class, and whether its plumage was oiled. Additional information was collected on bird activity and behavior, especially with regard to an oil slick. Census survey transects (usually 600 m wide) were conducted at a speed of 20 $km\ h^{-1}$ by the survey vessel in oiled and clear water on each sampling trip. Baiting experiments were conducted to observe activity, behavior, and effects of seabird/oil interaction. Dipping experiments were conducted and visual evaluations were made on the degree of fouling vs. thickness of slick and number of times dipped. Data processing involved transcription into computer code using Statistical Package by Social

Sciences (SPSS) format then analyses by several of the statistical packages (Chi-Square, ANOVA, Multiple Classification Analysis) available on SPSS.

SIGNIFICANT CONCLUSIONS: Out of nearly 300 seabird/oil references, only 12 were related to seabird behavior in the presence of oil. There was little evidence in these articles to suggest that seabirds are attracted to oil, but evidence indicated seabirds avoid or try to avoid making contact with oil. Previously oiled seabirds are more apt to avoid oil in the future. Seabirds making contact with silver or iridescent oil slicks (very thin slicks) are only lightly fouled and will not become mortally impaired from the encouter. Indications are that the large percentage of loon and grebe carcasses found on Santa Barbara beaches with oil on them probably resulted from the birds being oiled after they died from other causes. Diving birds are considered more at risk because their avoidance response (diving) increases their contact with the oil. Large numbers of non-diving species become oiled during a spill, but because many fly off to roost and are not accounted for, impacts have been underestimated in the past.

STUDY RESULTS: The literature review found nearly 300 seabird/oil research studies; about 70% were published in the last decade and only 12 were related to behavioral responses. Approximately 50 articles describe "catastrophic" oil spills, and how these spills have affected seabirds; 71 articles and four bibliographies are summaries or reviews of oil pollution problems that contain general information on the impact of oil pollution on seabirds; 37 articles deal with the rehabilitation of oiled birds and contain information on the extent that different species were oiled; and 32 articles describe the experimental toxicology of oil on birds.

Census data showed that seabird abundance in the study area was low as compared to the abundance of seabirds reported in the literature. Baiting experiments demonstrated that the age and/or residency status of seabirds related to the interaction of these birds with oil. Juvenile pelicans and gulls make contact with oil more often than adults, but a nonresident, regardless of age, is more apt to contact oil than is a resident. Analysis of field observation data indicates that, given the low frequency of contact with oil by loons and grebes, the large percentage of loon/grebe carcasses found on Santa Barbara beaches with oil on them may be the result of the carcasses being oiled after death from natural causes. Most of the birds observed (63.3%) on the water near oil slicks made no contact with oil. Less than 30% of the loons, grebes, shearwaters, ducks and geese, phalaropes, jargers, and turns observed made contact with oil, but approximately 40% of brown pelican, cormorants, and gulls made contact with oil.

The results of dipping experiments indicate that a bird's plumage does not become visibly fouled when making contact with silver and iridescent oil, but that plumage will become moderately to heavily fouled when making contact with satin, emulsified, or heavy oil. Silver and iridescent oil slick conditions predominate in the Santa Barbara Channel study area.

A response program was developed to make observations under spill conditions. The program was designed to mobilize a survey team to the site of an oil spill, where team members would analyze the effects of spilled oil on seabirds using methods devised while working in the Santa Barbara Channel. During the 18-month study period, there was no appropriate spill for the survey team to respond.

ACCESS NUMBER: **29102**

STUDY PRODUCT(S): Nero and Associates, Inc. 1983. Seabird-Oil Spill Behavior Study. A final report for U.S. Department of the Interior, Minerals Management Service Pacific OCS Office, Los Angeles, CA. Vol. I - NTIS No. PB84179530; Vol. II - NTIS No. PB84179548; Vol. III (Appendices) - NTIS No. PB84179555; Complete Set - NTIS No. PB84179522. Contract No. SBO408(a)-80-C-550/AA851-CT0-70.
79 pp.

Computer data tapes, video tapes, and 35-mm photographs were also generated as study products during the course of this project.

***P.I.'s affiliation may be different than that listed for Project Manager(s).**

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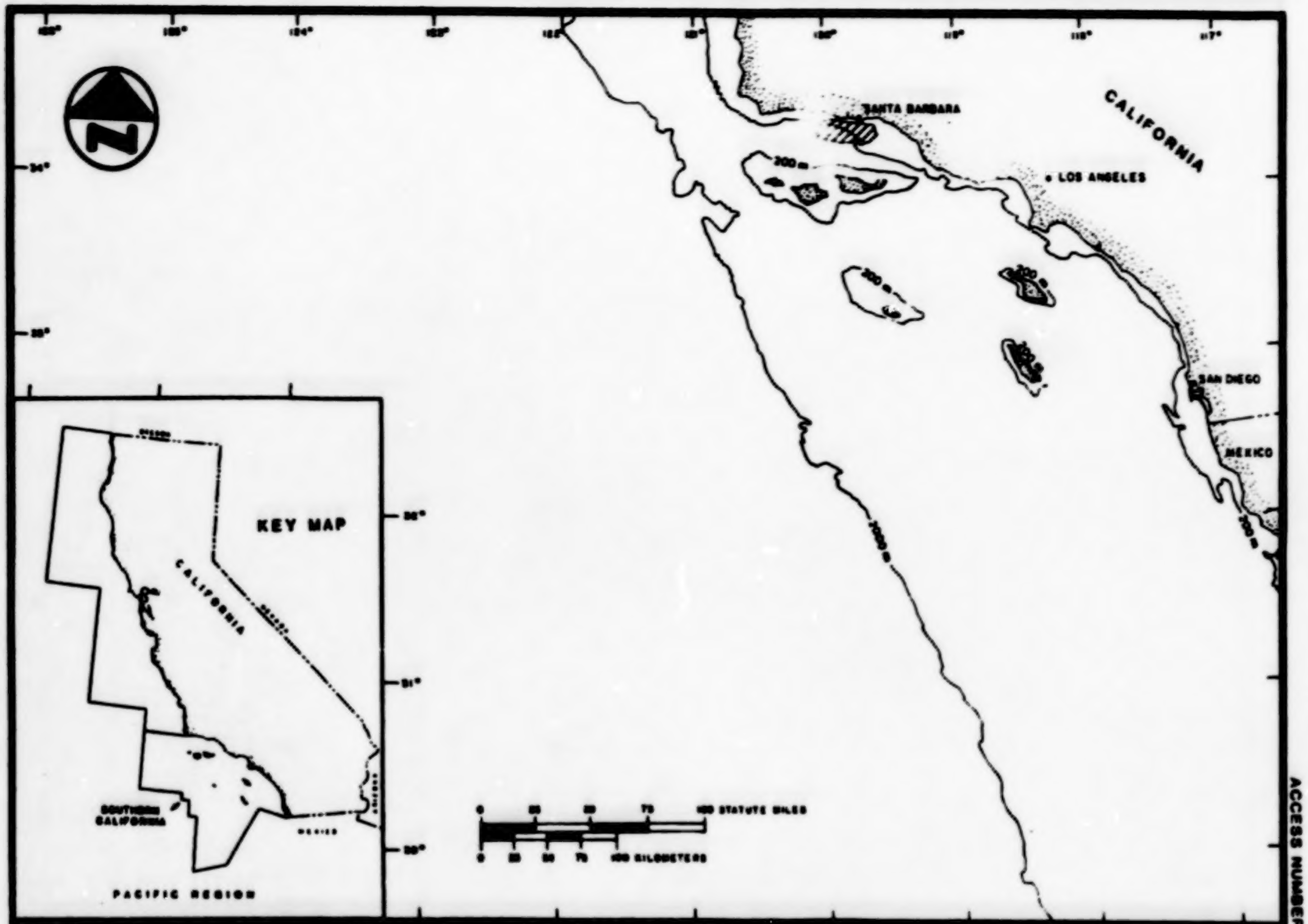

STUDY AREA SURVEYED DURING THE CALIFORNIA SEABIRD OIL SPILL BEHAVIOR STUDY.

ACCESS NUMBER: 29102

ACCESS NUMBER: 29102

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ACCESS NUMBER: **29122**

STUDY TITLE: Evaluation of Effluent Dispersion and Fate Models for OCS Platforms.

REPORT TITLE: An Evaluation of Effluent Dispersion and Fate Models for OCS Platforms. Vol. 1, Summary and Recommendations; Vol. 2, Contributed Papers.

CONTRACT NUMBER(S): BLM: CT2-54; MMS: 14-12-0001-29122.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California; Central and Northern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1982.

COMPLETION DATE OF REPORT: July 1983.

COST(S): FY 1982: $56,868; CUMULATIVE PROJECT COST: $56,868.

PROJECT MANAGER(S): R. Ware.

AFFILIATION: MBC Applied Environmental Sciences.

ADDRESS: 947 Newhall Street, Costa Mesa, California 92627.

PRINCIPAL INVESTIGATOR(S)*: L. Davis, R. Koh, A. Policastro, A. Runchal.

KEY WORDS: Southern California; Central and Northern California; fates and effects; drilling discharges; model; transport; dispersion; workshop; resuspension.

BACKGROUND: The Minerals Management Service (MMS) has responsibility for leasing oil and gas rights on the Federal Outer Continental Shelf (OCS) and for conducting studies to predict, assess, and manage impacts from oil and gas activities in the marine environment. One potentially significant impact is from effluent discharges from offshore drilling and production platforms. This report is the proceedings from an MMS-sponsored workshop held from 7 to 10 February 1983 in Santa Barbara, California to discuss strengths and limitations of available mathematical models for drilling effluent dispersion.

OBJECTIVES: (1) To survey and consolidate state-of-the-art knowledge in modeling the transport and fate of drilling muds, cuttings, and formation waters in OCS environments; (2) To educate Federal, State, and local agency personnel in uses and limitations of numerical models; (3) To compare discharged materials modeling uses and needs in relation to MMS and Environmental Protection Agency (EPA) mission responsibility; and (4) To provide feedback from MMS and EPA model users to scientists involved in developing and testing numerical models.

DESCRIPTION: A portion of the workshop was devoted to technical assessment of existing information related to drilling effluent discharges. Presentations consisted of descriptions of various models and their application to standard data sets. Papers presented included reviews of existing knowledge; standard data sets; laboratory experiments in plume behavior; drilling mud composition; sedimentation, resuspension, and flocculation processes; EPA modeling needs; and relationship of biological information needs to ocean-related discharge modeling and pollutant concentration predictions. A portion of the workshop included group discussions on specific aspects related to modeling of drilling effluent discharges. Topics included near-field physics, chemistry, and dynamics of discharged drilling effluent; dynamic effects of ambient oceanographic conditions on near and intermediate field drilling effluent; long-term oceanographic features of drilling effluent transport and fate; and the role of models in predicting and assessing drilling effluent behavior and effects.

SIGNIFICANT CONCLUSIONS: Currently available drilling effluent transport and fate models have only short-term applicability in the near-field. Most short-term models can simulate plume behavior in the initial dilution and dispersion phases but many other initial and subsequent processes are poorly understood, non-existent, or inadequately treated in existing models. Neither of the two currently available long-term prediction methodologies (deterministic and probabilistic) were considered satisfactory for application to OCS environments. The deterministic method requires a great deal of site-specific calibration and computer resources. The probabilistic method relies on representative oceanographic data samples and is more promising for potential OCS application. Limited field or laboratory data for model verification and calibration exists particularly for the processes of flocculation, deflocculation, sedimentation, and resuspension. Future investigation is needed concerning discharge plume interaction with the bottom, dilution due to discharge structure wake effect, initial separation of certain discharge constituents, and initial dilution due to pre-mixing. Synoptic data relevant to drilling effluent dispersal in the OCS environment are needed.

STUDY RESULTS: Available models should only be applied for short-term simulation of drilling effluent transport and fate. Applicability beyond one day is questionable; reasonable prediction is provided for discharge behavior in the near-field. These models remain largely unvalidated with field and laboratory data in the low densimetric Froude number range encountered with mud and produced water discharges. Typical laboratory data having high densimetric Froude numbers used to develop and calibrate model plumes are not directly applicable to drilling mud discharges. Plume buoyancy has pronounced effects on near-field dispersion and mixing requiring separate model calibration for the low Froude number range. After initial buoyancy and momentum of the mud plume have subsided, the plume enters into a passive diffusion phase which is thought to be the least accurate portion of short-term fate models.

Generally, plume behavior predictions from several short-term models for standard data sets were in agreement; however, predicted bottom deposition rates varied by an order of magnitude. Short-term models reasonably account for transfer and mixing processes in initial dilution and dispersion phases. Flocculation and deflocculation, deposition and resuspenison, and wake effect processes are either non-existent or inadequately treated in existing models. Certain initial processes (e.g., predilution in discharge pipe, and fine particle size separation from main plume) which have been noticed in field or laboratory studies are poorly understood. Standard data sets test only jet phase treatment in mud plume dispersion; the passive diffusion phase is not addressed.

Two long-term (day and longer) prediction methodologies are currently available: deterministic and probabilistic. None of the representative models presented at the workshop were considered satisfactory for application to OCS environments. The deterministic method requires a detailed description of synoptic oceanographic conditions for accurate prediction; such data are presently unavailable. Considerable computer resources required by this method may cause it to be cost prohibitive for OCS applications. The probabilistic method has promise but has not been explored sufficiently for OCS applications. Representative oceanographic data samples can be used, making this method cheaper than the deterministic method. A feasibility study to identify a suitable long-term drilling effluent methodology is recommended.

Adequate field or laboratory data for model verification and calibration are limited. Several processes including flocculation, deflocculation, sedimentation, and resuspension require further laboratory study. Additionally, phenomena of discharge plume interaction with the bottom, dilution due to discharge structure wake effects, initial separation of certain discharge constituents, and initial dilution due to pre-mixing need further investigation. Field data should be collected to validate short-term models and to develop long-term models. The data base should consist of synoptic data relevant to drilling effluent dispersal in OCS environments including information on ambient currents (including statistical parameters), temperature and salinity, natural and artificial sedimentation rates, and near-bottom sedimentation. Field data collection is likely to be most cost effective if conducted concurrent with, or pursuant to, development of a long-term fate model.

STUDY PRODUCT(S): Runchal, A. K. (Ed.). 1983. An Evaluation of Effluent Dispersion and Fate Models for OCS Platforms. Vol. 1, Summary and Recommendations. A final report by MBC Applied Environmental Sciences and Analytic and Computational Research, Inc. for the U.S. Department of the Interior, Minerals Management Service Pacific OCS Office, Los Angeles, CA. NTIS No. PB84166446. Contract No. 14-12-0001-29122. 85 pp.

Runchal, A. K. (Ed.). 1983. An Evaluation of Effluent Disperion and Fate Models for OCS Platforms. Vol. 2, Contributed Papers. A final report by MBC Applied Environmental Sciences and Analytic and Computational Research, Inc. for the U.S. Department of the Interior, Minerals Management Service Pacific OCS Office, Los Angeles, CA. NTIS No. PB84166453. Contract No. 14-12-0001-29122. 246 pp.

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*P.I.'s affiliation may be different than that listed for Project Manager(s).

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ACCESS NUMBER: **30056**

STUDY TITLE: Assessment of the Long-Term Fate and Effective Methods of Mitigation of California OCS Platform Particulate Discharges.

REPORT TITLE: Assessment of the Long-Term Fate and Effective Methods of Mitigation of California Outer Continental Shelf Platform Particulate Discharges. Vol. I, Final Report; Vol. II, Executive Summary.

CONTRACT NUMBER(S): MMS: 14-12-0001-30056.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California; Central and Northern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1983; 1985.

COMPLETION DATE OF REPORT: February 1985.

COST(S): FY 1983: $215,540; FY 1985: $3,997; CUMULATIVE PROJECT COST: $219,537.

PROJECT MANAGER(S): B. Balcom.

AFFILIATION: Continental Shelf Associates, Inc.

ADDRESS: 1695 Mesa Verde Avenue, Suite 200, Ventura, California 93003.

PRINCIPAL INVESTIGATOR(S)*: R. Barrick, G. Bigham, M. Brandsma, T. Dickey, K. Fucik, R. Kolpack, N. Phillips, F. Wu.

KEY WORDS: Southern California; Central and Northern California; Point Conception; Santa Barbara Channel; Santa Maria Basin; fates and effects; drilling discharges; modeling; mitigation; literature review; hydrography; data; currents; eddy; upwelling; sediment; transport; dilution; dispersion; resuspension; maps; deposition; seasonality; predilution.

BACKGROUND: Drilling for oil and gas resources on the outer continental shelf (OCS) off southern and central California has prompted concerns about environmental impacts of muds and cuttings discharges. This study provided an assessment of short-term and long-term fate and effective methods of mitigating discharges.

OBJECTIVES: (1) To describe the behavior of muds and cuttings from discharge to initial deposition (short-term fate) under representative California OCS conditions; (2) To review existing information concerning processes affecting the fate of discharges after deposition (long-term fate); (3) To evaluate mitigation measures, based on simulation modeling of short-term fate; and (4) To assess development of a mathematical model of long-term fate.

DESCRIPTION: Factors affecting short-term fate of muds and cuttings were explored using a computer simulation model. The Offshore Operators Committee (OOC) mathematical model was used to conduct 55 simulations (51 for muds and 4 for cuttings). Hydrographic and current speed data were selected for water depths of 30, 60, 190, 200, 480, and 750 m in the western Santa Barbara Channel [the 200 and 750 m simulations incorporated an eddy (rotary) circulation pattern] and 73 m off Point Conception (which incorporated upwelling). The typical conditions for the mud simulations were: discharge volume - 480 barrels; discharge rate - 120, 480, and 1,200 barrels per hour; predilution - none and 10:1; depth of discharge - 1 m (surface) and 40 m (shunted); and discharge pipe diameter - 0.3 m. For cuttings simulations, the same standard volume was discharged, but the discharge was assumed to contain only 1.93% cuttings by volume (the rest being wash water), and the discharge rate was 149 barrels per hour for the cuttings/wash water mixture. All cuttings discharges were assumed to be at the surface (no shunting). Mud samples were analyzed to determine particle settling velocities. Results were synthesized into two representative mud formulations differing in bulk density (light and heavy muds). Settling velocities for cuttings particles were calculated from published data and assembled into a characteristic cuttings data set.

Factors affecting long-term fate were described by reference to existing literature and data. The long-term fate assessment focused on: sediment transport processes and patterns; chemical processes affecting dissolution of barium and other metals, and degradation of lignosulfonates; and ways biological activities and products could make mud and cuttings deposits more or less likely to be dispersed.

SIGNIFICANT CONCLUSIONS: Short-term fate simulations showed that water depth, discharge depth, mud weight, current speed, and upwelling or downwelling conditions can significantly affect peak thickness and areal extent of drilling deposits. Predilution, altered discharge rate, and seasonal differences in water column density structure have relatively little effect, although altered discharge rate can significantly influence rate of initial dilution. Of the factors that affect short-term fate, water depth is a fixed quantity for a given discharge, and mud weight (composition) is determined by the particular drilling situation. The other factors can vary naturally or be controlled and therefore offer mitigation possibilities. There are two mitigation approaches: to create a small, thick pile of material, or to spread discharges over a wide area. If the objective is to create a small, thick pile, then discharges should be shunted to near bottom and discharged when currents are weak (and under downwelling conditions, if applicable). To disperse muds over a wide area, discharges should occur at the surface when currents are strong (and under upwelling conditions, if applicable). The latter is probably the better alternative in most situations. However, it may be more appropriate to localize deposits when drilling occurs near a habitat containing biota sensitive to sedimentation.

The long-term fate review and assessment indicate that most drilling muds and cuttings will eventually be transported off the continental slope or to offshore basins that also receive the bulk of sediments supplied by rivers. Long-term fate will never be as predictable as short-term fate. Development of a comprehensive fate model is not recommended. However, resuspension and redistribution near drillsites during and after drilling should be the focus of future modeling efforts.

STUDY RESULTS: In most simulations, contour maps and burial plots indicated that a small area near the discharge point received the greatest accumulation of discharges. Despite overall similarity of deposition patterns produced from various simulations, predicted values for peak thickness and area affected varied widely. In light mud simulations, peak thickness ranged from 0.13 to 382 um and area affected ranged from 0 to 1.3 km^2. Mud accumulations were thicker in shallow than in deep water. In heavy mud simulations, peak thickness ranged from 0.08 to 5,878 um and area affected ranged from 0 to 3.5 km^2. Heavy mud settled faster and produced thicker, more localized deposits than light mud. In cuttings simulations, peak thickness ranged from 1.66 to 171 um and area affected ranged from 0.13 to 0.26 km^2. Cuttings accumulations tended to be much more localized than light or heavy muds. To evaluate mitigation options, simulation results were compared under conditions that could vary at a drillsite. When muds were shunted rather than surface discharged, the resulting peak thickness of drilling muds was greater. The difference was much more pronounced in shallow water than in deep water. Discharge rate had little or no influence on peak thickness.

Predilution of muds produced a 36% lower peak thickness for a surface discharge in 60 m water depth, but had little or no effect in 190 m. As current speed increased, discharges were more rapidly and widely dispersed, and peak thicknesses decreased. Seasonal differences in water column density profile had very little influence on peak thickness. In Point Conception simulations, peak thickness was greater under downwelling conditions than under upwelling conditions. Most rapid dilution occurs immediately upon release when the momentum of the plume creates turbulent mixing of particles with seawater near the discharge pipe. Muds or cuttings are diluted by a factor of several hundred or several thousand to one within the first few minutes. Discharge rate and current speed are the major factors that determine initial dilution rate. The 10:1 predilution of muds had little influence on overall dilution rate. Initial rapid dilution depends on its ability to force its way through the seawater below the discharge pipe. Prediluted discharges are less dense than standard discharges and do not generate as much turbulent mixing.

Sediments have a common, predictable long-term fate. In general, they are carried along the California coast in a southerly direction and are eventually intercepted by submarine canyons, which incise the continental shelf. Canyons divert sediment to a row of nearshore basins, where the material is likely to remain. Projected annual inputs of muds from drilling in the Santa Barbara Channel and the Santa Maria Basin are approximately 0.06 to 0.07% of the sediment load that would be expected to reach the adjacent basins from nearby rivers during a flood year and 1.3 to 1.6% of those during a dry year. At most, cuttings would contribute about the same percentages as muds. Two major components of muds whose fate could be influenced by chemical processes are barite and lignosulfonates. Release of barium (and other metals) to the water column is expected to be low. The structural similarity of lignosulfonates to better-studied natural lignin polymers suggests that little or no chemical (or biological) degradation will occur. Muds and cuttings deposition may have localized effects on sediment chemistry. Although muds and cuttings themselves do not have high oxygen demand, sufficiently thick accumulations could produce anoxia in underlying sediments by preventing or limiting exchange of oxygen between sediments and overlying water. Exchange of some chemical constituents between sediments and water may be enhanced under anoxic conditions. Biological processes could indirectly affect the fate of mud and cuttings deposits by making them more or less susceptible to erosion. Direct effects on fate via biological uptake, transformation, and breakdown of mud constituents are expected to be minor.

STUDY PRODUCT(S): Continental Shelf Associates, Inc. 1985. Assessment of the Long-Term Fate and Effective Methods of Mitigation of California Outer Continental Shelf Platform Particulate Discharges. Vol. I, Final Report; Vol. II, Executive Summary. A final report for the U.S. Department of the Interior, Minerals Management Service Pacific OCS Region, Los Angeles, CA. MMS Report 85-0033. Contract No. 14-12-0001-30056. 2 volumes.

*P.I.'s affiliation may be different than that listed for Project Manager(s).

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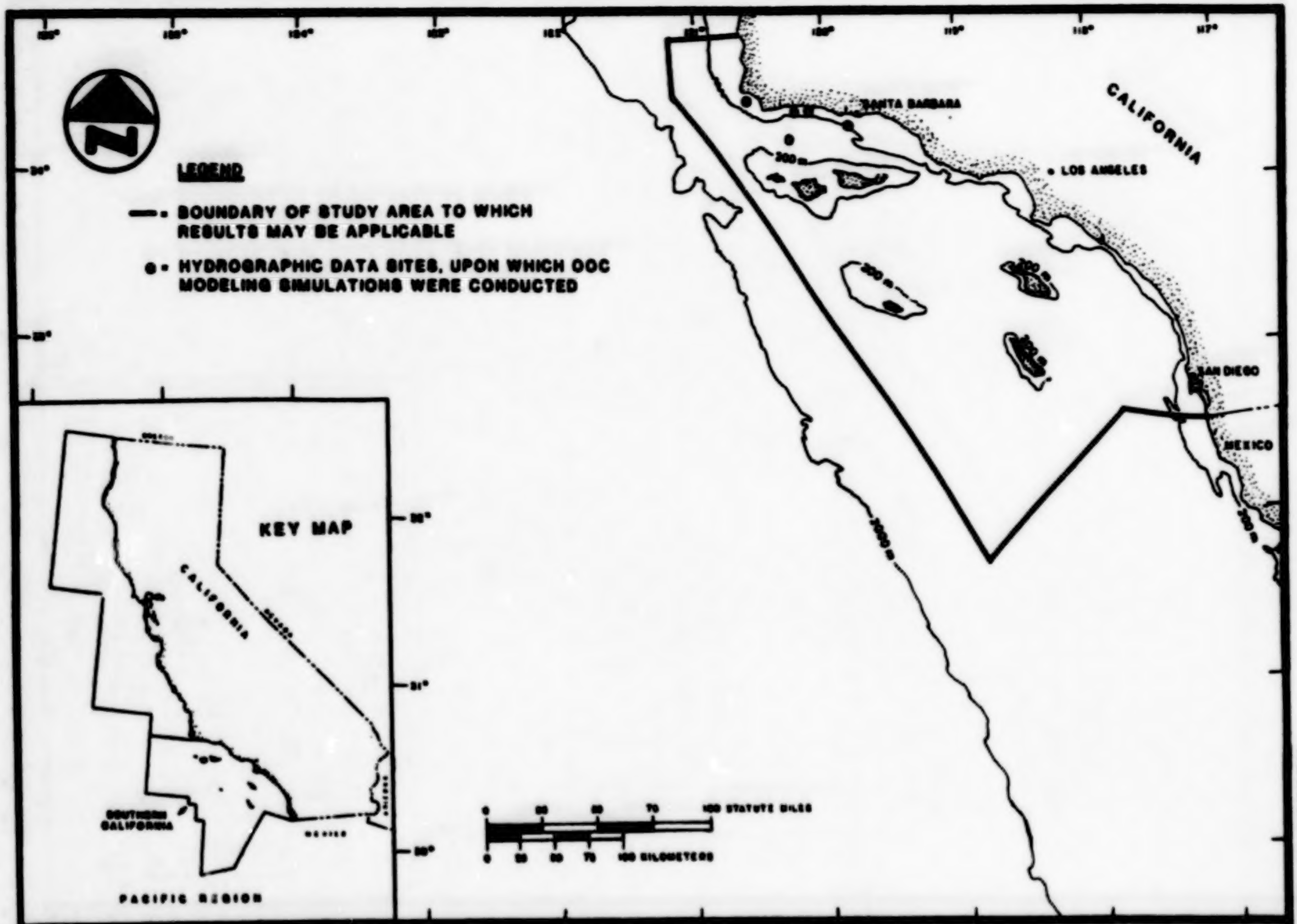
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MEXICO
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KEY MAP
CALIFORNIA
SOUTHERN CALIFORNIA
PACIFIC REGION
0 25 50 75 100 STATUTE MILES
0 25 50 75 100 KILOMETERS

STUDY AREA FOR ASSESSMENT OF THE LONG-TERM FATE AND EFFECTIVE METHODS OF MITIGATION OF CALIFORNIA OCS PLATFORM PARTICULATE DISCHARGES.

ACCESS NUMBER:30056

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Physical Oceanography

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ACCESS NUMBER: **IA9-02**

STUDY TITLE: Climatology and Oceanographic Analysis of the California Pacific Outer Continental Shelf Region.

REPORT TITLE: A Climatology and Oceanographic Analysis of the California Pacific Outer Continental Shelf Region.

CONTRACT NUMBER(S): BLM: IA9-02.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California; Central and Northern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1979; 1980.

COMPLETION DATE OF REPORT: September 1981.

COST(S): FY 1979: $344,100; FY 1980: $59,600; CUMULATIVE PROJECT COST: $393,700.

PROJECT MANAGER(S): R. Williams.

AFFILIATION: Environmental Data and Information Service.

ADDRESS: National Oceanic and Atmospheric Administration.

PRINCIPAL INVESTIGATOR(S)*: M. Earle, F. Godshall, G. Halliwell, C. Mooers, R. Williams.

KEY WORDS: Southern California; Central and Northern California; physical oceanography; meteorology; California Countercurrent; nutrients; seasonality; currents; shelf; slope; upwelling; Davidson Current; California Current; Southern California Bight.

BACKGROUND: The report describes the results of the acquisition and synthesis of historical meteorologic and oceanographic data collected on the California Pacific Outer Continental Shelf (OCS). It was performed under Interagency Contract No. AA551-IA9-2 between the U.S. Department of the Interior, Bureau of Land Management, and the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data and Information Service. The California OCS region was defined as the area between the Mexican border to the Oregon State boundary and seaward to the shelf edge or 200 km. A larger area was examined in several components of the study to describe conditions upstream and downstream of potential oil and gas lease areas.

OBJECTIVES: (1) To provide data summaries of historical physical oceanographic and meteorologic data for the California region; (2) To synthesize and interpret the summarized data, identifying the most significant features; and (3) To determine inadequacies in the data and to offer recommendations for future work.

DESCRIPTION: Meteorologic data were obtained primarily from the National Climatic Center, Asheville, North Carolina, and included National Weather Service and U.S. Coast Guard coastal station records and standard shipboard marine surface observations. Most oceanographic data were obtained from the National Oceanographic Data Center (NODC), Washington, D.C. Current meter data were obtained from the U.S. Naval Oceanographic Office, Bay St. Louis, Mississippi. Water elevation data were obtained from the National Ocean Survey. A few data sets were provided by private investigators. Limited editing was undertaken for most data sets, and consisted generally of rejecting those values which were outside physically reasonable bounds. Because natural scatter in dissolved oxygen and nutrient chemical values is normally quite high, and the number of observations small, no quality control was done on these data prior to analysis. In addition, no quality control beyond that routinely performed by NODC was carried out for mechanical or expendable bathythermograph observations. Standard meteorologic and oceanographic techniques were utilized in the reduction and synthesis of historical data.

SIGNIFICANT CONCLUSIONS: Atmospheric stability measurements are not routinely available, thus the best assumption is that the boundary layer over water is extremely stable and atmospheric pollutants will be transported with little dispersion over the ocean. Temperature, salinity, and dissolved oxygen concentration data are adequate to describe monthly variations at 100-km resolution in the Southern California Bight; however, northwest of San Francisco, only seasonal descriptions can be made. Data are also insufficient to resolve hydrographic features of the California Countercurrent System, whose component circulations would have a significant influence on the advection and dispersion of spilled pollutants and drilling muds. In addition, data are not sufficient to delineate synoptic and mesoscale features such as river plumes, fronts, and upwelling zones. Except for phosphate, nutrient chemistry data available in the NODC archive is entirely inadequate to assess geographic distribution in California coastal waters on a seasonal basis. In all seasons, phosphate appears to be rather uniform in its geographic distribution. There is a major deficiency of current meter observations; however, mean currents generally agree with previous reviews and syntheses of the general circulation in the California OCS region. Highest water elevations in the California OCS region are caused by infrequent tsunamis, which usually do not cause damage to properly designed structures. Considerable damage can be caused by extreme wave conditions resulting from winter extratropical storms in the North Pacific which reach the coast of Southern California.

STUDY RESULTS: Meteorologic data summaries provide background statistics on mean flow characteristics, visibility reductions, and probability of occurrence of extreme events. During winter, flow over the ocean is generally westerly off Northern California and northwesterly off Southern California. During spring, speed increases and mean flow becomes uniform over the entire area; after April, flow is from the northwest in all areas over the open ocean. The mean northwesterly flow continues through summer, with mean speeds as high as 18 kn off the Northern California coast. In autumn, there is a weakening of force and a change to a more westerly flow. Wind roses for coastal areas are more complicated and show effects of topography and local circulation. During daytime, land is heated more strongly than the sea, resulting in creation of flow from sea to land. A diurnal pattern ensues, with a sea breeze during the day and a land breeze at night. During the day, when the prevailing onshore flow is enhanced by the sea breeze, the air over land is more unstable than the air over water; thus, pollutants will be dispersed through a thicker layer. At night, when the land breeze is developed, nearshore atmospheric pollutants will be carried seaward.

Wind speeds exceeding 33 kn occur about 1% of the time in January, but less than 0.1% in July. Fog occurs 31% of the time in July, but only 9% during January. Thunderstorms are extremly rare, occurring less than 0.1% of the time in July and never in January. Relative humidity is greater than 90% for 66% of the observations in January, but for 83% of the observations in July.

Available hydrographic, ship drift, moored current meter, and drifter data tend to support existing knowledge of currents over the shelf and slope off California, but cannot provide good estimates of monthly long-term mean currents over most of the region. These data sets show the expected seasonal changes in mean near-surface flow. Ship drift charts show a seaward component to mean surface current vectors at all times of the year; mean speeds are on the order of 10 $cm\ s^{-1}$ for both poleward and equatorward flow periods. Streaks of higher speed (20 to 40 $cm\ s^{-1}$) are recorded for certain areas. Seasons were defined according to three discernible circulation periods: (1) the winter or Davidson Current period in December-January; (2) the spring or upwelling period in May-July; and (3) the fall or oceanic period in September-October.

There are two fundamental water mass structures in the California OCS region. The first is a southern water structure of equatorial origin having a salinity of about 33.4 ppt and a temperature of 8 to 22 C. The second is subarctic water transported to the region by the California Current. This latter water mass has a lower mean salinity of about 33 ppt and a temperature range of about 7 to 17 C. A case can be made for a third type that is found in the Southern California Bight which has a slightly higher temperature and salinity than either of the other two.

Historic NODC archive data were insufficient to draw any conclusions regarding the monthly geographic distribution of nitrate, nitrite, or silicate. Phosphate was fairly homogeneous in geographic distribution in all seasons.

Tabular and descriptive data were presented on components that contribute to the total water elevation, i.e., storm surges, astronomical tides, seasonal and long-term sea level changes, tsunamis, normal and extreme waves, and wave set ups.

STUDY PRODUCT(S): Godshall, F. A. and R. G. Williams (eds.). 1981. A Climatology and Oceanographic Analysis of the California Pacific Outer Continental Shelf Region. A final report by the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data and Information Service for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. Contract No. AA551-IA9-02. 298 pp.

Williams, R. G., R. W. Reeves, F. A. Godshall, and S. W. Fehler. 1980. A Climatology and Oceanographic Analysis of the California Pacific Outer Continental Shelf Region. A final report by the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data and Information Service for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. NTIS No. PB82192220. Contract No. AA551-IA9-02. 1,182 pp.

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*P.I.'s affiliation may be different than that listed for Project Manager(s).

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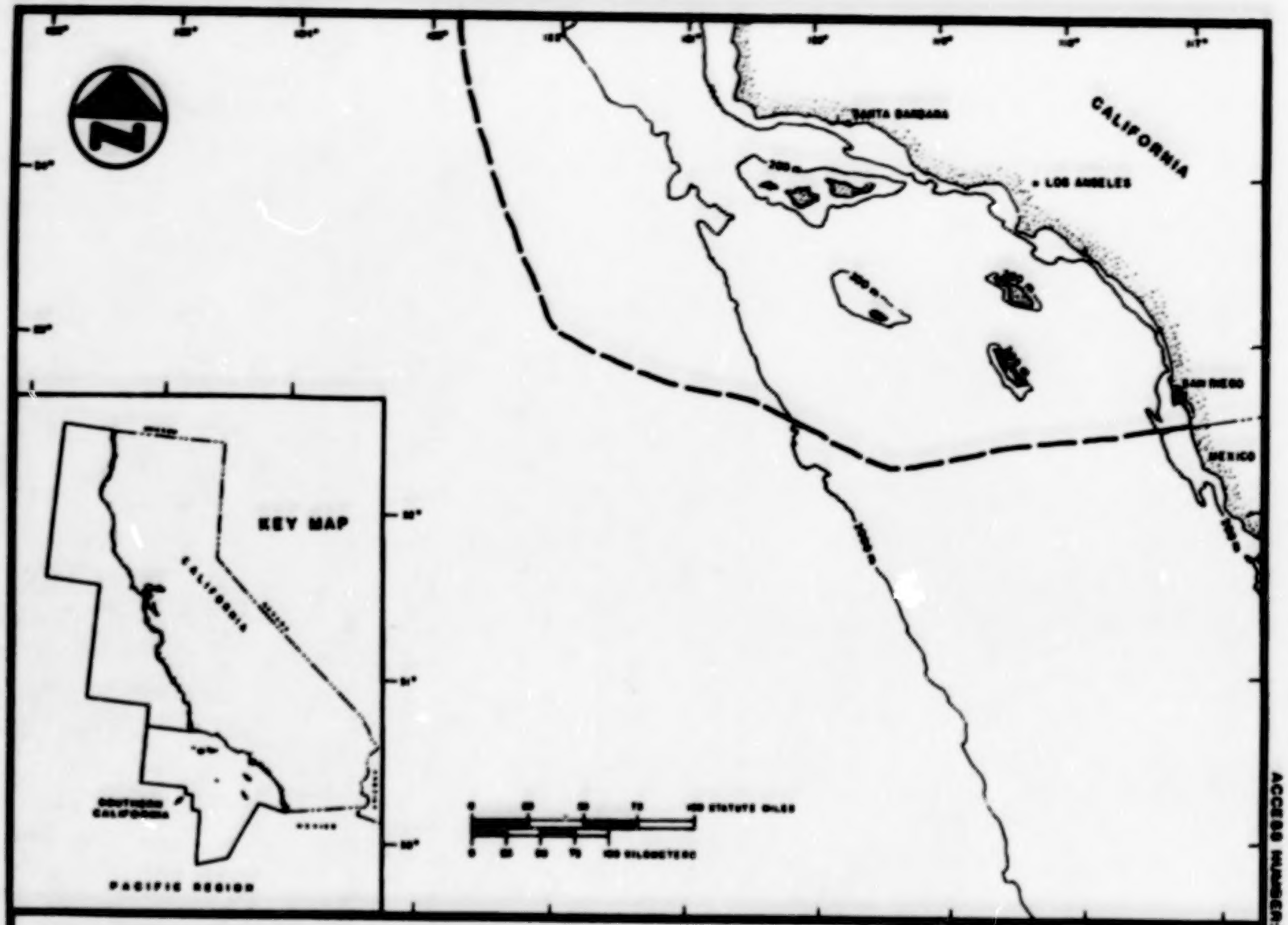

STUDY AREA FOR THE CLIMATOLOGY AND OCEANOGRAPHIC ANALYSIS OF THE CALIFORNIA PACIFIC OCS.

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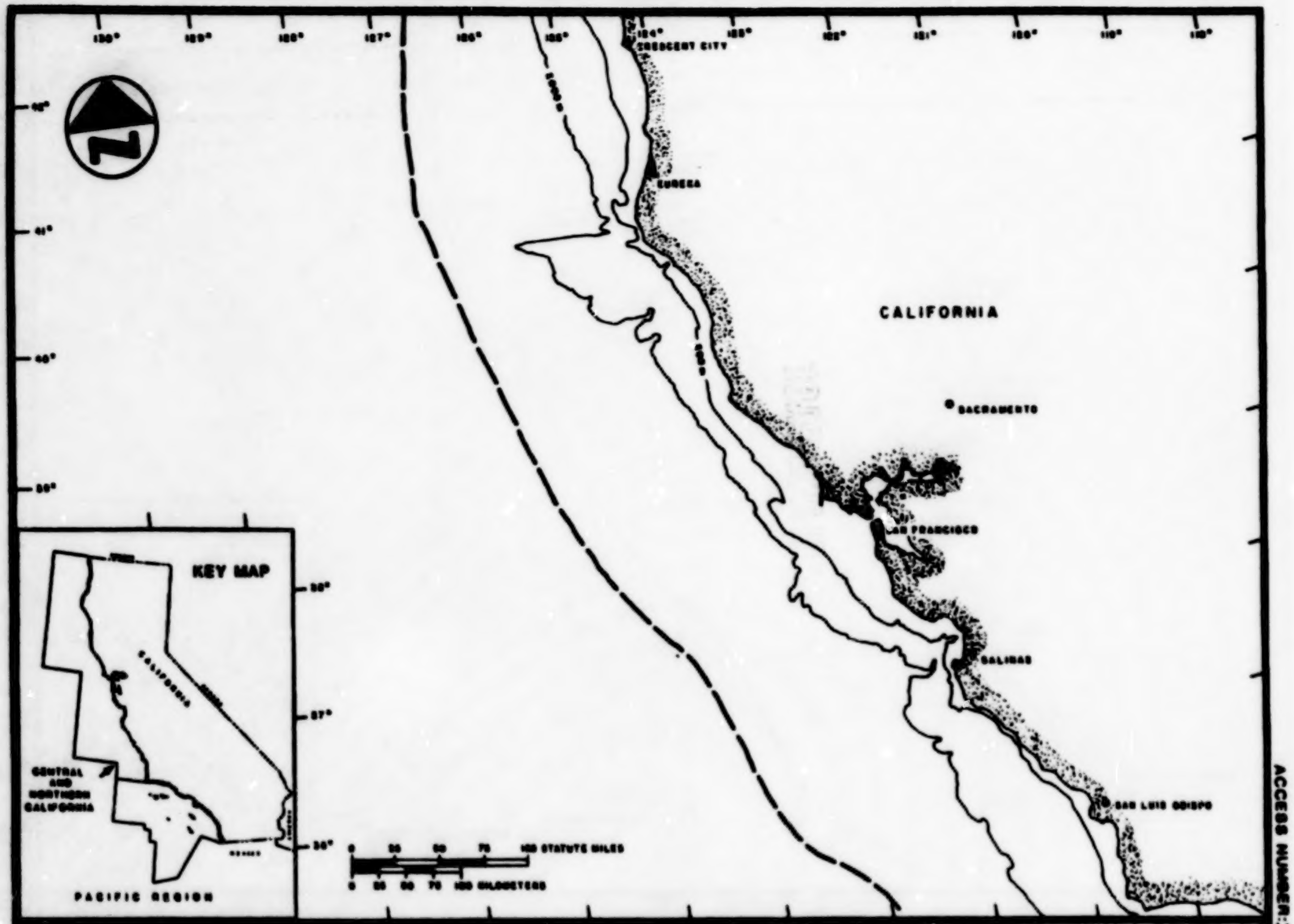

STUDY AREA FOR THE CLIMATOLOGY AND OCEANOGRAPHIC ANALYSIS OF THE CALIFORNIA PACIFIC OCS.

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ACCESS NUMBER: **29113**

STUDY TITLE: California Shelf Physical Oceanography Circulation Model.

REPORT TITLE: California Shelf Physical Oceanography Circulation Model.
Vols. 1 and 2.

CONTRACT NUMBER(S): BLM: CT1-67; MMS: 14-12-0001-29113.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California; Central and Northern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1981; 1982.

COMPLETION DATE OF REPORT: October 1984.

COST(S): FY 1981: $573,063; FY 1982: $4,671; CUMULATIVE PROJECT COST: $577,734.

PROJECT MANAGER(S): H. Herring.

AFFILIATION: Dynalysis of Princeton.

ADDRESS: 219 Wall Street, Princeton, New Jersey 08540-1512.

PRINCIPAL INVESTIGATOR(S)*: A. Blumberg, H. Herring, L. Kantha, G. Mellor.

KEY WORDS: Southern California; Central and Northern California; physical oceanography; modeling; hydrography; California Current; currents; wind forcing.

BACKGROUND: The predominant features of circulation off the coast of California are nearshore coastal upwelling and the offshore California Current System (CCS). A clear understanding of the circulation in California's coastal waters and the ability to predict this circulation are necessary for an assessment of the environmental impacts of future exploration or development on the California outer continental shelf (OCS). The limited and variable spatial and temporal information pertaining to coastal water masses off California precludes a comprehensive understanding of its circulation. Numerical modeling is an important and cost-effective tool in understanding coastal circulation, particularly as it relates to the potential transport and dispersion of surface and subsurface pollutants attributed to oil and gas operations.

OBJECTIVES: (1) To develop a three-dimensional time dependent general circulation model (GCM) of the California shelf employing an orthogonal (i.e., perpendicular) curvilinear coordinate system; (2) To review and edit available historic hydrographic and climatological data files for the California offshore region; and (3) To conduct a year-long prognostic simulation using the GCM to produce a one-year catalogue of synoptic currents and associated wind stress fields.

DESCRIPTION: The geographic (or grid) boundaries of the GCM were established so as to encompass potential spill sites with sufficient detail on the California shelf while also accounting for the effect of deep ocean circulation on shelf circulation. The western boundary, located 500 km offshore, was situated to encompass a majority of the CCS. The southern boundary, located near 32 N Lat, was situated where the California Current returns to a flow parallel to the coast following its interaction with southern California's offshore islands. The northern boundary was positioned at 42 N Lat, just beyond Cape Mendocino.

A series of factors may influence coastal currents, including local and large-scale windpatterns, air-sea heat and moisture fluxes, coastline shape, seafloor topography (along with baroclinicity), and non-local forcing effects (e.g., tides, propagating coastal-trapped waves). The effects of these factors, termed open boundary conditions, were introduced into the modeling effort through the use of the Characteristic Tracing Model (CTM). The CTM used hydrographic, bathymetric, and wind stress data to provide diagnostic currents in the water column. The CTM grid boundaries, which encompassed the GCM grid, were set as follows: (1) northern boundary at 50 N Lat, to encompass the northern regions of the CCS; (2) southern boundary at 20 N Lat; and (3) western boundary positioned considerably beyond the lateral boundary of the GCM. The selection of an appropriate orthogonal curvilinear grid (OCG) was an iterative process designed to provide appropriate nearshore resolution while keeping computational costs realistic. In order to resolve the mean coastline profile, the computational grid was established with 40 alongshore and 30 offshore divisions. The average alongshore grid spacing was approximately 35 km (resolution range: 16-50 km), with the highest resolution near coastal promontories. The offshore grid spacing ranged from 4 to 25 km. Vertical resolution was incorporated into the model by the use of 21 points distributed with an irregular spacing to provide increased resolution near the surface and bottom of the water column. The data analysis and synthesis aspects of the program required evaluation of hydrographic and meteorological data sets, both of which were important in initialization of the model. For hydrography, historical archives from the National Oceanographic Data Center, Fleet Numerical Oceanography Center, and the California Cooperative Fisheries Investigation survey series were reviewed. Following data review and editing, a composite data set comprised of 276,757 instrument deployments (casts) was compiled for the domain of interest. Approximately 40,000 casts provided temperature and salinity measurements necessary to deduce water mass density distributions. These data were used to derive seasonal climatology with a 1/2 resolution extending from Baja California to Vancouver Island and extending 1,000 km offshore. Meteorological data, required to provide surface boundary conditions for both prognostic (GCM) and diagnostic (GCM, CTM) modeling, were acquired from historical Marine Surface Observations records archived at the National Climatic Center. Specifics detailing the wind stress and heat flux for an entire year were drawn from National Oceanic and Atmospheric Administration Data Buoy Center and National Weather Service records. Aside from the problem of preferential coastal influence on wind velocity data (as compared to barometric pressure field data), the wind stress fields were interpolated to the OCG of the GCM at 6-h intervals. Diagnostic simulations of the climatological circulation on the California shelf, conducted using the GCM, provided an indication of shelf circulation and initialized the subsequent prognostic modeling. A prognostic simulation and comparison of modeling results with available historic records for an entire year (1981) was conducted using the GCM. Because model results indicated a deviation from climatology in deeper layers, the prognostic modeling was conducted in three phases - winter/spring (Phase 1), summer (Phase 2), and fall (Phase 3).

SIGNIFICANT CONCLUSIONS: Results of the year-long prognostic simulation for 1981 provided a catalogue of synoptic currents and associated wind fields for the CCS and the California shelf. Circulation patterns derived from these results were consistent with many observed shelf circulation features.

STUDY RESULTS: Results of the GCM diagnostic modeling were generally consistent with current knowledge regarding the long-term currents along the California coast. Annual or mean circulation patterns were properly represented. Model results were provided for annual mean currents at 2-m, 200-m, and 1,000-m water depths. Near surface current velocities ($15\ \text{cm s}^{-1}$) reflected the influence of the strong and steady coastal winds, while offshore wind fields. At depths below 50 m, where strong northward nearshore currents (8 cm s^{-1}) were evident in the Southern California Bight (SCB) and north of Point Sur, the influences of wind forcing were diminished and density-driven current patterns were prominent. Current distributions at 200 m reflected strong, jet-like southward nearshore currents and weak, generally southward offshore currents. At 1,000 m, relatively strong (2 cm s^{-1}) and generally southward currents were evident. Seasonal variations in the diagnostic mode of the GCM results were also consistent with observed characteristics. Strongest near surface currents (15 cm s^{-1}) were evident in spring and summer, while weakest near surface flows (5 cm s^{-1}) were noted in fall. Surface currents were generally southward throughout the domain, except nearshore and in the northern portion of the grid where prevailing winds exerted their influence. There was no clear manifestation of a closed cyclonic eddy in the SCB in any of the seasonal surface circulation results. Seasonal variation was evident in subsurface currents at depths below 50 m. In the nearshore, northward currents at 200 m were evident up to Point Sur in fall and winter and reflected weaker flows in spring and summer. In contrast to the nearshore currents, offshore currents exhibited little variability with minor exception. Offshore flow was generally southward; net transport in the water column was similar in all seasons. Deep (1,000 m) currents were predominantly southward, relatively strong (3 cm s^{-1}), and tended to closely follow topographic contours. Sea surface elevation distributions also revealed a seasonal variation attributed to wind field variability.

Results of the year-long GCM prognostic simulation of California shelf circulation, when compared to 1981 field observations or diagnostic climatological means (from the previous GCM diagnostic simulations), were well behaved and reflected the anticipated characteristics of the spring transition. Near surface currents close to shore were generally northward during winter, while flowing southward in spring and summer. Nearshore currents were generally more intense off northern and central California. As expected, subsurface currents exhibited less seasonal variability than surface currents. However, eddy activity was not well represented in the results because of the coarse grid resolution. For sea surface elevations, only winter and fall distributions were similar to climatological distributions. Winter and fall temperature distributions in near surface waters were similar (0.5 C colder overall) to climatological results, while spring and summer results were roughly similar. Subsurface temperature fields at 200 m and below were very similar to climatological fields. Near surface salinity distributions reflected the influence of sizeable freshwater outflows from San Francisco Bay and the Eel River.

STUDY PRODUCT(S): Blumberg, A. F., L. H. Kantha, H. J. Herring, and G. L. Mellor. 1984. California Shelf Physical Oceanography Circulation Model. A final report prepared by Dynalysis of Princeton for the U.S. Department of the Interior, Minerals Management Service Pacific OCS Region, Los Angeles, CA. Contract No. 14-12-0001-29113. 2 volumes. 368 pp.

Study products also include Appendices (Climatological Atlas, Diagnostic Model Results, Prognostic Model Results, and Scientific Review) and computer tapes.

*P.I.'s affiliation may be different than that listed for Project Manager(s).

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ACCESS NUMBER: **CT7-32**

STUDY TITLE: Southern California Bight Archaeological Literature Survey and Sensitivity Zone Mapping.

REPORT TITLE: Archaeological Literature Survey and Sensitivity Zone Mapping of the Southern California Bight Area.

CONTRACT NUMBER(S): BLM: CT7-32.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1977.

COMPLETION DATE OF REPORT: October 1978.

COST(S): FY 1977: $100,641; CUMULATIVE PROJECT COST: $100,641.

PROJECT MANAGER(S): E. Mishuck.

AFFILIATION: Science Applications, Inc.

ADDRESS: P.O. Box 2351, 1200 Prospect Street, La Jolla, California 92037.

PRINCIPAL INVESTIGATOR(S)*: E. Stickel, W. Gayman, A. Ross.

KEY WORDS: Southern California; Southern California Bight; cultural resources; archeology; literature review; geology; maps; sensitivity; Santa Barbara Channel; Santa Catalina Island; San Diego.

BACKGROUND: A summary of archeological information for the Southern California Bight was not readily available in the literature. This study was intended to provide a synthesis and to address the issue of mitigation or preservation of archeological/cultural resources associated with Oil and Gas Lease Sales 35 and 48.

OBJECTIVES: (1) To review and assess all available published and unpublished literature and file data concerning cultural resources, related geology and geomorphology of the Late Quaternary period, and the paleontological resources of the Southern California Bight; (2) To develop maps, overlays, and descriptive narratives depicting known terrestrial and underwater cultural resource sites in the Outer Continental Shelf (OCS) region and extending 300 m landward of mean high tide; (3) To develop sensitivity zones based on geomorphic features, oceanographic and meteorologic conditions, early shipping routes, etc.; and (4) To identify and discuss significant cultural resources and paleontological data gaps.

DESCRIPTION: The synthesis and assessment parts of this study were based on reviews of published and unpublished reports, interviews and experts in the field, and reviews of collected data on geology, oceanography, geomorphology, archeology, and paleontology of the Southern California Bight. Most archeological information was on cards or in notebooks. All data collected were organized by zone. Most archeological sites were plotted on relevant U.S. Geological Survey 7.5-min maps and entered into a computer file. Sensitivity maps were constructed based primarily on expert judgments of the compilers because numbers were too small to constitute a statistically valid sample or lack of confidence in some data. Sensitivity was based on the number of sites per unit area and not in terms of their actual or potential scientific value.

SIGNIFICANT CONCLUSIONS: There are approximately 4,737 prehistoric sites, 582 submerged wrecks, and 274 historic sites within the Southern California Bight. There was poor correlation between site data and geomorphic features. Most of the mainland coast and all of the offshore islands are highly sensitive to known and inferred cultural resources. It was estimated that only 5% of the terrestrial part of the study area and virtually none of the marine area has been adequately surveyed by qualified archeologists. Any development within the area should be preceded by a thorough field survey.

STUDY RESULTS: Three major ethnographic areas in Southern California were recognized based upon the native inhabitants: the Chumash (occupied Channel Islands and Santa Barbara coast down to Topanga Canyon), the Gabrielino (from Topango south to Aliso Creek), and various southern groups (San Diego Coast). Consequently, the study area was divided into three zones: Zone 1, the northern section called "Santa Barbara Channel and Environs"; Zone 2, referred to as "Santa Catalina and Environs"; and Zone 3, referred to as "San Diego Coast and Environs." Four map sets were prepared which contain paleontological resources of public or scientific value, including vertebrate, invertebrate, and plant fossil sites.

There was sufficient archeological data to suggest that the area was occupied by man during terminal Pleistocene/Early Holocene times. Because sea level at that time may have been as much as 50 m below the present sea level, a good potential existed for early settlement on what is now the continental shelf. More underwater prehistoric sites occur in the Southern California Bight than in any other area off the coast of the United States. Offshore sensitivity zones were classified as having: (1) high sensitivity (0 to -100 m), (2) medium sensitivity (-100 to -150 m), and (3) low sensitivity (-150 to maximum ocean depth).

A synthesis of historic sites demonstrated that most sites are in clusters around early Spanish missions and at harbors. Less important sites are registered at sea resorts.

The Southern California Bight has high potential for cultural resources. Under 2,000 sites have been identified as a part of this study and an inventory of close to 5,000 sites is anticipated at the conclusion of several in-progress studies. The actual number is believed to be still greater in view of the small percentage of the study area that has been surveyed to date. Continued literature searches and systematic field surveys are recommended, particularly for those areas being considered for mineral development. These should be conducted by qualified archeologists and other cultural resource scientists. Proper statistical sampling designs and analytical procedures are recommended for underwater surveys requiring the use of either remote sensing or scuba search techniques.

STUDY PRODUCT(S): Science Applications, Inc. 1978. Archaeological Literature Survey and Sensitivity Zone Mapping of the Southern California Bight Area. A final report for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. Vol. I - NTIS No. PB290-741/AS; Vol. II (Appendices) - NTIS No. PB294-518/AS. Contract No. AA550-CT7-32. 320 pp.

Sensitivity maps, computer listing of sites.

*P.I.'s affiliation may be different than that listed for Project Manager(s).

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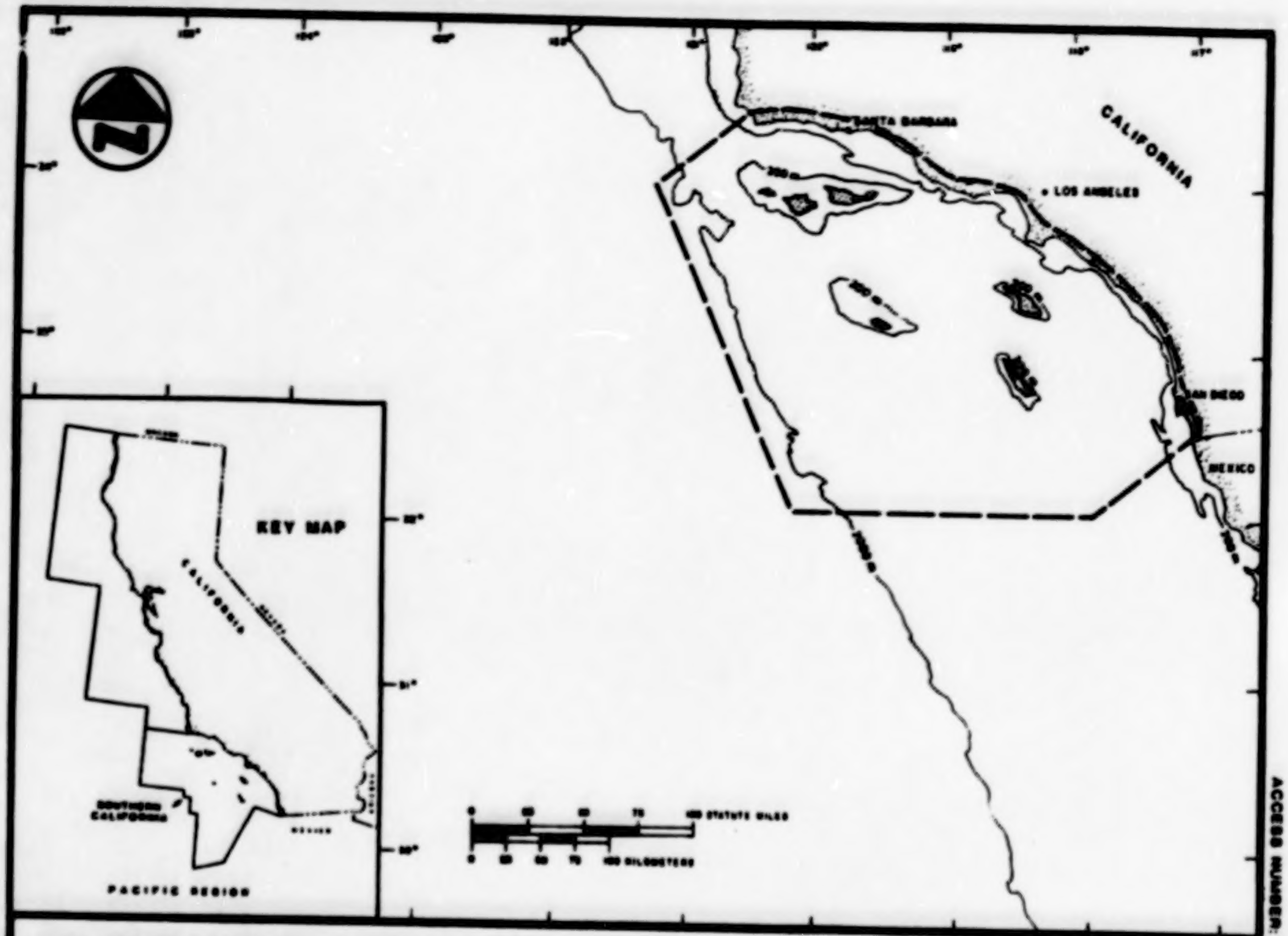

STUDY AREA FOR THE SOUTHERN CALIFORNIA BIGHT ARCHEOLOGICAL LITERATURE SURVEY AND SENSITIVITY ZONE MAPPING.

ACCESS NUMBER: CT7-32

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ACCESS NUMBER: **29019**

STUDY TITLE: California Coastal Recreation and Aesthetics Study.

REPORT TITLE: Inventory and Evaluation of California Coastal Recreation and Aesthetic Resources.

CONTRACT NUMBER(S): BLM: CT0-63; MMS: 14-12-0001-29019.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California; Central and Northern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1980; 1981.

COMPLETION DATE OF REPORT: May 1981.

COST(S): FY 1980: $155,353; FY 1981: $80,623; CUMULATIVE PROJECT COST: $235,976.

PROJECT MANAGER(S): T. Miller.

AFFILIATION: The Granville Corporation.

ADDRESS: 1133 15th Street N.W., Suite 1100, Washington, D.C. 20005.

PRINCIPAL INVESTIGATOR(S)*: T. Miller.

KEY WORDS: Southern California; Central and Northern California; socioeconomics; recreation; aesthetics; coastal zone; tourism; modeling; mitigation; inventory.

BACKGROUND: The existence of summary information pertaining to the coastal recreation of California shorelines and offshore areas is extremely sparse. Available information is found scattered in a variety of publications. The California Department of Parks and Recreation has kept records for several years of the attendance at State-owned beach facilities. "Seasonal Participation in Boating Activities, 1980" and "Seasonal Participation in Sport Fishing Activities, 1978" summarize the seasonal boating, party, and charter boat operations in the State. Aesthetic resources of the California coastline have been analyzed in several previous studies, including the Final Environmental Impact Statement for Outer Continental Shelf (OCS) Lease Sale 53 off Central and Northern California, the California Coastal Plan, Comprehensive Ocean Area Plan, California Coastline Preservation and Recreation Plan, and several locally-sponsored documents.

OBJECTIVES: (1) To catalog the recreational resources of the California coastline and to provide data on the level of usage by recreationists; (2) To catalog and evaluate the aesthetic resources of the California coastline; (3) To develop information on the dollar value of recreational activities to recreationists; (4) To obtain data on daily per capita tourist expenditures; (5) To develop data on the importance of recreation and tourism to California's coastal economies; (6) To evaluate the potential effects of OCS development on the aesthetic ranking of coastal landscape units; and (7) To devise a method to determine the extent to which changes in the aesthetic ranking of a coastal landscape unit will change the level of participation in recreational activities in that unit.

DESCRIPTION: Aesthetic and recreational data were organized in such a manner as to be applicable to the Bureau of Land Management's onshore oil spill risk assessment model and the model's unit of measure—the coastal segment (50 segments averaging 27 mi in length). Landscape units were used to further refine the characteristics/resources assigned to each segment. Descriptions of coastal and offshore recreational activities and resources were divided into: beach use, boating, and sport fishing. Levels of recent and current participation in these recreational activities were reported. Projections of anticipated participation levels through the year 2010 were based upon 43 regression analyses for which long-term historical data were available. California's coastal aesthetic resources and aesthetic quality were rated by landscape unit, based on an aesthetic resource classification system developed specifically for the California coast. The classification system divided aesthetic resources into scenic resources and other aesthetic considerations. The potential effects of five hypothetical OCS-related scenarios were evaluated in terms of how the development could alter aesthetic perceptions. Scenarios included the presence of: (1) a single platform 3 mi (5 km) offshore; (2) a group of four platforms 3 mi (5 km) offshore; (3) a storage and treatment facility located 3 mi (5 km) offshore; (4) a 5-acre onshore processing plant; and (5) a 25-acre onshore supply and operations base.

The potential economic effects on recreation and tourism resulting from OCS oil and gas activities in California were also provided. Three types of economic values included: a dollar estimate of the loss to human welfare of recreationists who choose to forego a coastal recreation participation day due to OCS development activities; the average dollar amount spent by a tourist during a coastal recreation participation day; and a listing of multipliers which indicate the total effects on area economic activity, earnings, and employment that will result from changes in tourist spending. Regression models were also developed to approximate the relationships between OCS operations and the level of participation in recreational activities.

SIGNIFICANT CONCLUSIONS: Most of California's shoreline recreational activity occurs during summer months, with peak activity in July. Beach recreational activities, open beach activities, and water-related recreational activities were identified, in decreasing order of popularity, as the predominant forms of beach use. Study results indicated a preponderance of coastal segments evaluated as being of high, medium-high, and medium value. Development on the OCS is expected to decrease to some extent the aesthetic value of nearly half of California's coast.

STUDY RESULTS: A majority of the recreational activity along California's shoreline occurs during the summer months (June-September), with a peak activity evident in July (1980 data). Beach recreational activities, including sunbathing and walking, were the predominant forms of activities and were generally followed in decreasing order of popularity by open beach activities (outdoor sports, hanggliding) and water-related recreational activities (e.g., swimming, wading). Between Big Sur and Gaviota, water-related activities were notably more popular than open beach activities. Water contact recreation were also minimal in segments north of Pt. Reyes (segment 14). Participation in pleasure boating off the California coast normally was four to six times more common than participation in sailing. Sport fishing activities were almost uniformly divided (about 30% each) between private vessels and man-made structures (e.g., piers, jetties), and fishing from the shoreline. The remaining 10% consisted of party or charter boat activity (in Central and Northern California only). In Southern California, party or charter boat activity was higher (22%) and shoreline fishing decreased to 18%. Fishing activity was seasonally dependent. Major seasonal activities include salmon fishing (February to April) and fishing for bottom fish (June to October). The tourist influx during summer (June to September) also increased the participation levels evident in fishing activity statistics. Detailed recreational resource descriptions (major beaches, coastal recreational sources, peak use periods, and prominent sightseeing or recreational points) were presented by coastal segment. In general, beach use in future years is expected to increase, although identified decreases in usage on more remote coastal segments were expected to continue to decline. Sport fishing was also expected to increase in regions where heavy activity was noted.

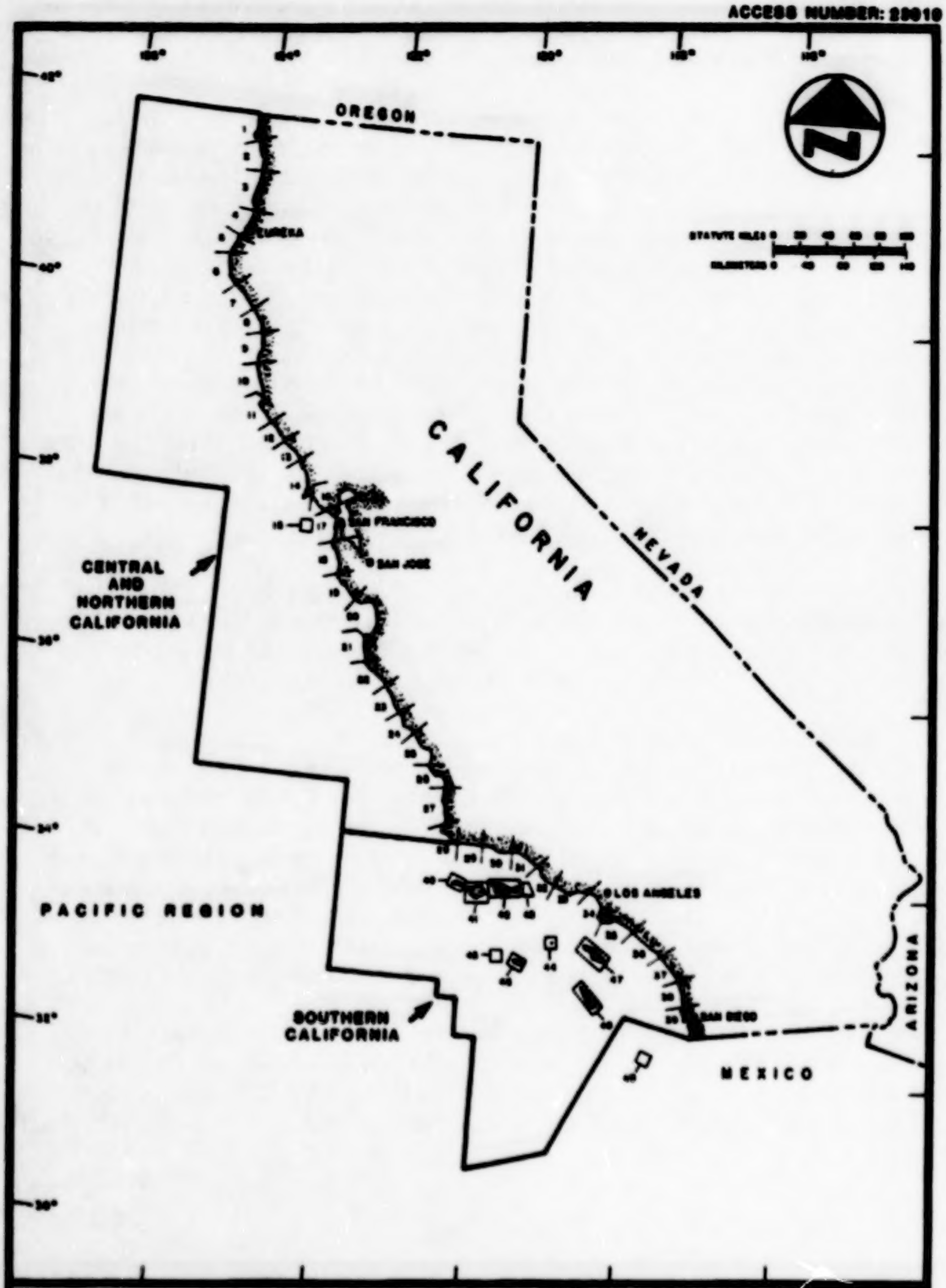
In terms of the aesthetic value scores assigned to each coastline segment, the study results indicated a preponderance of high, medium-high, and medium scores for the entire California coast. The classification system developed and utilized in this study was based on the Visual Management System (VMS); the VMS was modified and scenic (70 points maximum) and aesthetic resources (30 points maximum) were then evaluated. Medium scores indicate a point total of at least 49 points. Regarding the potential effect (i.e., negative aesthetic value impact) of the five OCS development scenarios, the study noted that 50% of the landscape units along the California coast, including 75% of those in Central and Northern California, would realize some deterioration in aesthetic ratings as a result of OCS development. In general, the proposed presence of only one offshore platform had the least effect. Offshore facilities will also be less aesthetically detrimental than onshore facilities, although careful site selection and design of onshore facilities can obviate negative impacts in most landscape units; the exceptions to this finding included those landscape units that received high overall aesthetic ratings (>83 points). In these cases, site selection and design solutions will not be able to satisfactorily mitigate the negative impact on aesthetic resources.

Identified changes in tourist spending indicated that the largest local economic impact per dollar of reduced tourist expenditure would occur in Southern California (i.e., Ventura, Los Angeles, Orange, and San Diego Counties). The smallest impact would be exhibited in Northern California (i.e., Del Norte, Humboldt, and Mendocino Counties).

Results from the regression models indicated that Northern and Central California beach usage: (1) increased if commercial facilities (e.g., hotels, restaurants) were near the beach; (2) generally decreased in areas where numerous shore facilities were present and generally increased in more pristine wilderness areas; (3) increased when the extent of aesthetically pleasing trails increased; and (4) increased when the acres of aesthetically pleasing day-use area increased. Limited data on day-use acreage and miles of trails existed. For Southern California, beach usage: (1) increased when the amount of aesthetically pleasing beach front increased; (2) decreased when the amount of wetlands along the beach front increased; and (3) decreased when the distance to the beach from the nearest parking area increased.

STUDY PRODUCT(S): Miller, T. 1981. Inventory and Evaluation of California Coastal Recreation and Aesthetic Resources. A final report by the Granville Corporation for the U.S. Department of the Interior, Bureau of Land Management Pacific OCS Office, Los Angeles, CA. Vol. I - NTIS NO. PB82-192295; Vol. II - NTIS No. PB82-192303. Contract No. AA550-CT0-63. POCS Tech. Paper No. 81-5. 693 pp.

*P.I.'s affiliation may be different than that listed for Project Manager(s).



GEOGRAPHIC LOCATION OF THE COASTAL SEGMENTS USED AS THE BASIS FOR EVALUATION OF CALIFORNIA'S COASTAL AND OFFSHORE RECREATION AND AESTHETIC RESOURCES.

ACCESS NUMBER: **30026**

STUDY TITLE: Cumulative Socioeconomic Impacts of Oil and Gas Development in the Santa Barbara Channel Region: A Case Study.

REPORT TITLE: Cumulative Socioeconomic Impacts of Oil and Gas Development in the Santa Barbara Channel Region: A Case Study. Vols. I and II.

CONTRACT NUMBER(S): MMS: 14-12-0001-30026.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1983.

COMPLETION DATE OF REPORT: August 1984.

COST(S): FY 1983: $171,200; CUMULATIVE PROJECT COST: $171,200.

PROJECT MANAGER(S): M. Frankel.

AFFILIATION: Centaur Associates, Inc.

ADDRESS: 1120 Connecticut Avenue, N.W., Suite 465, Washington, D.C. 20036.

PRINCIPAL INVESTIGATOR(S)*: M. Frankel.

KEY WORDS: Southern California; Santa Barbara Channel; economics and demographics; socioeconomics; cumulative impact; development; model; forecast; exploratory drilling.

BACKGROUND: The Minerals Management Service (MMS) is charged with environmental impact statements preparation for lease sales. To support this effort, the MMS must collect necessary biological, environmental, and socioeconomic data. This retrospective study was undertaken to assess the baseline socioeconomic environment of Santa Barbara and Ventura Counties between 1960 and 1983, and thereby, to develop better understanding of relationships between oil and gas development and the area socioeconomic environment, and to improve predictive methods of socioeconomic impacts associated with future oil and gas development.

OBJECTIVES: (1) To profile socioeconomic environments of Santa Barbara and Ventura Counties from 1960 to 1983; (2) To determine impacts of oil and gas development on those environments; (3) To compare estimated impacts with previous predictive studies; and (4) To determine applicability of study results to other California coastal counties.

DESCRIPTION: The study was conducted primarily using secondary sources. Approximately 60 socioeconomic characteristics were profiled for both Santa Barbara and Ventura Counties. Estimates of actual effects of offshore oil and gas development in Federal and State waters were made on selected characteristics using regression analysis and a regional economic model. Multivariate regression analysis was used because oil and gas development is only one of several factors affecting the socioeconomic environment in recent years. Eighteen of the 60 socioeconomic variables were chosen as dependent variables which were assumed dependent on, or caused by, changes in a variety of independent or exogenous factors. A regional economic model analysis, a forecasting and simulation approach, of the Santa Barbara Channel region was the second technique used to estimate offshore oil and gas development impacts. A 496-sector [four digit Standard Industrial Classification (SIC) Code] input/output model was aggregated with a forecasting model for detailed analysis of interindustry impacts as well as cost, location, and factor substitution effects over time. The applicability of these results was tested against other coastal California counties.

SIGNIFICANT CONCLUSIONS: Profiles of Santa Barbara and Ventura Counties showed that the Santa Barbara Channel region underwent significant demographic and economic growth in the 1960s and 1970s. Oil and gas development played a relatively small role in that growth; growth would have been similar in the absence of oil and gas development. Federal oil and gas activity was shown to have slightly greater impact than State activity although neither were a dominant development force. There currently exist more highly developed techniques to assess impacts of oil and gas development than existed previously. Study results were shown to be applicable to California coastal counties of similar size and economic structure; however, differences did exist in socioeconomic relationships of larger California coastal counties and Santa Barbara and Ventura Counties.

STUDY RESULTS: The socioeconomic profile of the Santa Barbara Channel region forms the basis for estimating impact extent of offshore oil and gas development. For both Santa Barbara and Ventura Counties, the 60 selected socioeconomic variables focused on demographic and economic characteristics, energy use, land uses, and several other characteristics directly related to offshore oil and gas development. The profiles of the two counties showed that the Santa Barbara Channel region underwent significant demographic and economic growth in the 1960s and 1970s.

The Outer Continental Shelf (OCS) oil and gas industry was characterized by key factors such as numbers of wells, production figures, and employment. About 375 million barrels of oil and 650 billion cubic feet of gas were extracted in the Santa Barbara Channel area between 1960 and 1982. Between 1967 and 1982, 158 exploratory wells and 424 development wells were drilled in California State and Federal offshore waters. Yearly new well numbers in State waters were highest in the 1960s, thereafter dropping to nearly zero after the 1969 Santa Barbara blowout until the late 1970s when seven to eight wells were drilled each year. Drilling activities in Federal waters commenced in 1966 and were highest until the early 1970s. Oil and gas production followed the trend of drilling activity.

The study included oil and gas associated local purchases and direct employment estimates. Oil and gas purchases directly affected 180 industries. Support industries were service related because of lack of manufacturing in the counties. Large oil company expenditures connected with offshore activity (e.g., drilling rigs, production platforms, and pipelines) during the study period were not made locally. Relationships between oil companies and local suppliers and ability of supplier to meet offshore industry needs have evolved over time. A larger portion of industry spending now remains in the study area.

The basic form of the regression analysis was to use socioeconomic indicators as dependent variables. Those variables were regressed against various subsets of independent variables representing oil and gas and non-oil and non-gas development for control and standardization of effect and isolation of oil and gas development effect. To address the issue of the importance of oil and gas activity, a comparison of estimated impact and value of each dependent variable was undertaken. Typically, oil and gas activity accounted for less than 5% of dependent variable value. According to the regional economic mode analysis, Federal and State oil and gas activity had little impact on local economy in each county. Impacts in each industry ranged between 0 and 12.9% of control forecast values with the majority of impacts less than 5%. Industries most impacted were mining and construction; those least affected included retail trade and manufacturing. Years of highest impacts coincided with greatest amounts of exploration, development, and production (late 1960s and early 1970s). Study findings demonstrated improved ways to measure socioeconomic impacts of oil and gas development. The regression analysis was found to have limited applicability, particularly to large California coastal counties. The regional economic model had general applicability to all California coastal counties. Both analytical techniques had two important advantages: (1) as a cross-check on results of each analysis; and (2) as means to address a wide range of socioeconomic indicators.

STUDY PRODUCT(S): Centaur Associates, Inc. 1984. Cumulative Socioeconomic Impacts of Oil and Gas Development in the Santa Barbara Channel Region: A Case Study. Vol. I, Final Report. A final report of the U.S. Department of the Interior, Minerals Management Service Pacific OCS Region, Los Angeles, CA. NTIS No. 85135978. Contract No. 14-12-0001-30026. 326 pp.

Centaur Associates, Inc. 1984. Cumulative Socioeconomic Impacts of Oil and Gas Development in the Santa Barbara Channel Region: A Case Study. Vol. II, Appendices. A final report for the U.S. Department of the Interior, Minerals Management Service Pacific OCS Region, Los Angeles, CA. Contract No. 14-12-0001-30026. 269 pp.

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*P.I.'s affiliation may be different than that listed for Project Manager(s).

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ACCESS NUMBER: **30050**

STUDY TITLE: Assessment of Conflicts Between Bottom Disturbances Associated with Offshore Pipeline and Commercial Trawl Fisheries.

REPORT TITLE: Mitigation of Sea Floor Conflicts Between Oil and Gas Pipelines and Commercial Trawl Fisheries on the California Outer Continental Shelf.

CONTRACT NUMBER(S): MMS: 14-12-0001-30050.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): All.

FISCAL YEAR(S) OF PROJECT FUNDING: 1983.

COMPLETION DATE OF REPORT: July 1984.

COST(S): FY 1983: $212,268; CUMULATIVE PROJECT COST: $212,268.

PROJECT MANAGER(S): B. Ingram.

AFFILIATION: Centaur Associates, Inc.

ADDRESS: 1120 Connecticut Avenue, N.W., Suite 465, Washington D.C. 20036.

PRINCIPAL INVESTIGATOR(S)*: L. de Wit, B. Ingram, H. Shatto.

KEY WORDS: North Atlantic; Mid-Atlantic; South Atlantic; Eastern Gulf; Central Gulf; Western Gulf; Southern California; Central and Northern California; Gulf of Alaska; Kodiak; Cook Inlet; Shumagin; North Aleutian Basin; St. George Basin; St. Matthew Hall; Navarin Basin; Norton Basin; Hope Basin; Barrow Arch; Diapir Field; San Diego; Morro Bay; Santa Barbara Channel; fishing economics; commercial fishing; pipeline; mitigation; synthesis; anchor damage; case histories.

BACKGROUND: Pipeline construction associated with offshore oil and gas development has been prevalent on the central and southern California Outer Continental Shelf (OCS). Attendant activities, particularly anchoring by work vessels, cause considerable seafloor alterations which may eventually result in gear loss by bottom trawl fishing operations. Concerned about the plight of the fishermen, the U.S. Department of the Interior sponsored studies designed to determine how to lessen the severity of the pipeline activities or restore damaged areas to render them trawlable.

OBJECTIVES: (1) To identify and evaluate measures to minimize and mitigate sea floor conflicts between bottom disturbances caused by oil and gas pipeline activities and commercial trawl fishing offshore California.

DESCRIPTION: This desktop study began by reviewing pipeline technology and searching for alternative pipeline installation techniques to minimize anchor disturbances within the target area (Morro Bay to the Mexican border and offshore to the 1000-m isobath). Trawl fishing operations off central and southern California were reviewed and current fishing locations identified. Next, available data were synthesized to assess environmental conditions that could potentially affect bottom conditions or that could amplify anchor disturbances. A series of regional case studies were examined to gain insights from previous experiences with anchor scars and mitigation attempts in other areas including California, the North Sea, and Japan.

From the combined study efforts, potential mitigating measures were reviewed as they applied to the study area.

SIGNIFICANT CONCLUSIONS: Along a particular pipeline route, potential for conflict with trawl fishing operations may arise in areas where significant amounts of bottom trawling occur, where anchor-based pipeline installation methods were employed, and where silt and clay bottom sediments predominate. Pipepull is the most widely used pipeline installation method used offshore California. Although anchors are normally used for positioning, the pipepull method can be accomplished by using tugs which eliminate the need for anchors. Future pipeline installations off California will be expected to employ the bottom pull method using an anchored pull barge and conventional dynamic positioning. Methods which do not involve anchor use are available but are expensive. Silt and clay bottom types are most prone to anchor damage. Fishing operations have been affected by anchor scars, usually by the actual trenches and not the mounds of sediment. Case studies revealed anchor scarring was a problem to bottom trawling where bottoms were clay or silt; however, other associated debris and submerged gear also caused conflicts with towed bottom fishing gear. The most successful mitigation efforts resulted when operators contracted fisherman to restore damaged bottom areas. Potential mitigating measures are as follows: (1) development of pipeline installation techniques which eliminate the use of anchors; (2) selection of proper anchors for the anticipated loads; (3) practice of careful anchor handling techniques; (4) restoration of previously scarred areas; (5) modification of trawl or fishing gear to minimize problems when encountering anchor scars; and (6) rerouting of pipelines around trawling areas or areas of susceptible bottom sediments.

STUDY RESULTS: There are two primary categories of undersea pipeline installation techniques: pipepull and pipelay. Pipepull involved welding sections of pipe together onshore or on a floating barge; the resulting pipeline is then pulled into place by a tug or by a winch on an anchored barge. Variations of pipepull include bottom pull, near bottom pull, surface pull, and near surface pull. If a tug is used to make a bottom pull, no anchor scars will result. Lower costs favor the use of an anchored barge over a dynamically positioned barge. Surface and near surface pull methods are not widely used in offshore pipe installation technology. The pipelaying method is accomplished by welding the pipe sections into a continuous string on a lay barge then lowering the pipeline into position on the seafloor. Standard lay barges use an array of 8 to 12 anchors, set from 300 to 3,000 m. The barge is pulled ahead in increments corresponding to individual pipe sections. Another technology, the reel method, employs a spool of pipe mounted on a barge which is deployed by unspooling the roll. Pipepull is the most popular method of pipeline installation used offshore California. Holding capacities of anchors may vary with design and weight. Recently designed stocked anchors provide better handling capacity than the presently used stockless anchors. Anchoring difficulties include improper fluke angle and instability.

Bottom trawl fisheries between Morro Bay and San Diego have historically exploited flatfish, rockfish, and shrimp. Recently, croaker and sea cucumbers have become fisheries of some importance off Ventura and Santa Barbara. Most trawling is done from stern trawlers and double rig shrimp boats. The type and size of nets used depend on vessel size, target species, and bottom type. All nets have otterboards made of steel or wood which attach to the net by bridles.

Silt and clay bottoms have the greatest potential to be scarred by anchors. These areas occur mostly offshore of the shelf break and locally in some low energy environments. Wind, waves, and currents can directly affect anchoring systems if the holding capacity of the anchor is marginal. Currents in the study area vary throughout the year but were not of a magnitude to cause anchor scarring. Winds and waves were most severe during winter and early spring.

Three case studies revealed certain aspects of anchor damage in other areas. In 1980, a pipeline was laid between Platforms Hope and Grace in the Santa Barbara Channel. Following construction, there were numerous anchor scars and considerable problems with mud fouling fishermen's trawl nets. The problem was apparently associated with mud trenches, not mud mounds. The trenches had steep walls of very stiff clay. A total of 450 anchor scars were identified using side scan sonar. Attempts to restore the areas by dragging an I-beam across the damaged bottoms proved unsuccessful. By late 1983, a follow-up trawl survey revealed the scarring to be greatly reduced. It was not clear whether bioerosion or water movements had leveled the scars. The United Kingdom Sector of the North Sea is the site of considerable pipeline construction and commercial trawling. Although there are various conflicts with underwater installations and fishing efforts, anchor scars do not represent a major problem. Most anchor scars do not persist here due to high energy conditions and a sandy bottom. Anchor scars were a problem in the northern portion of the North Sea with predominantly clay bottoms. Surveys conducted with remotely operated vehicles revealed the scars to be 50 m or less in length and 1.5 m deep. In Japan, anchor damage was reported for pipelines where the bottom was primarily mud and clay. After several unsuccessful attempts to restore damaged bottoms, Japanese operators contracted fishermen to design and execute mitigation plans for the affected sites. A fisheries cooperative handled all mitigation efforts and reported their success at 90 to 95%. Their method involved two vessels towing a cable across the affected bottom areas.

Costs associated with pipeline installation techniques specifically to avoid the use of anchors are \$144,000 km^{-1} of pipeline. The non-anchor installation techniques include dynamic positioning using the reel method of pipelaying, dynamic positioning using conventional pipelaying techniques, and pipe pull techniques using no anchors. Proper anchoring techniques can significantly reduce the severity of anchor scar problems at a minimal cost. Trawl clearance operations or smoothing could cost between \$3,500 to \$11,000 km^{-1} of pipeline. Costs of rerouting pipeline could vary depending on geometry of the pipeline route and amount of pipeline material required, and could exceed \$1,000,000 mi^{-1} of pipeline. Tests for minimizing the effects of anchor scars on trawl fishing gear include: anchor testing to ensure adequate holding and minimal disturbances, test trawling after pipeline installation, and testing of restoration techniques.

STUDY PRODUCT(S): Centaur Associates, Inc., Dames and Moore, Harry Shatto, Consulting Engineer, and VTN, Inc. 1984. Mitigation of Sea Floor Conflicts Between Oil and Gas Pipelines and Commercial Trawl Fisheries on the California Outer Continental Shelf. A final report for the U.S. Department of the Interior, Minerals Management Service Pacific OCS Region, Los Angeles, CA. NTIS No. PB85134476. Contract No. 14-12-0001-30050. 426 pp.

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*P.I.'s affiliation may be different than that listed for Project Manager(s).

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ACCESS NUMBER: **30164**

STUDY TITLE: Development of Baseline Data for Socioeconomic Modeling in Northern Santa Barbara County and San Luis Obispo County.

REPORT TITLE: Economic and Demographic Profile of San Luis Obispo County, California.

CONTRACT NUMBER(S): MMS: 14-12-0001-30164.

SPONSORING OCS REGION: Pacific.

APPLICABLE PLANNING AREA(S): Southern California; Central and Northern California.

FISCAL YEAR(S) OF PROJECT FUNDING: 1984.

COMPLETION DATE OF REPORT: May 1985.

COST(S): FY 1984: $126,446; CUMULATIVE PROJECT COST: $126,446.

PROJECT MANAGER(S): K. Fernandez.

AFFILIATION: ECOS Management Criteria, Inc.

ADDRESS: 5300 Orange Avenue, Suite 200, Cypress, California 90630.

PRINCIPAL INVESTIGATOR(S)*: T. Campbell.

KEY WORDS: Southern California; Central and Northern California; economics and demographics; socioeconomics; baseline; data; modeling; demographics; leasing; development; impacts.

BACKGROUND: The Minerals Management Service provides information for management decisions concerning Outer Continental Shelf (OCS) offshore leasing projects in compliance with the National Environmental Policy Act of 1969. Development of oil and gas resources off the California coast requires environmental analyses of potential exploration, development, and production impacts. Socioeconomic impact analysis of San Luis Obispo County is required for expected offshore oil and gas development in the Santa Maria Basin north of Point Conception.

OBJECTIVES: (1) To develop an economic and demographic baseline profile of San Luis Obispo County.

DESCRIPTION: This socioeconomic profile is based on existing time series data collected from Federal, State, and local governments. The profile and projections use 1980 as the base year. Trends and projections are based on time series beginning with 1960 data points in most cases. Comprehensive socioeconomic data for San Luis Obispo County are grouped into the following seven major data resource profiles: land area and natural resources, demographic characteristics, economic characteristics, land use, public finance, community services, and energy consumption.

SIGNIFICANT CONCLUSIONS: Potential offshore Federal oil and gas leasing and development activities along the San Luis Obispo County coast could result in increases in direct and related industries employment. Accordingly, the average County wage rate would increase proportionately from increases in direct and indirect oil and gas employment and related local tax subvention revenues. Higher average wage rates characteristic of the oil and gas industry would directly and indirectly influence both employment level and average wage rate in San Luis Obispo County. Potential employment and wage increases could also result in a broader local tax base. The County could also realize effective local tax rate reductions from increases in the economic export base associated with Federal leasing and development of oil and gas resources.

STUDY RESULTS: San Luis Obispo County is located on the California coast between San Francisco and Los Angeles and is the 15th largest County in the State. Primary land use is low to moderate yield agriculture. Most urban settlement in the County occurs along the coastal plain; coastal communities comprise more than 61% of the total population. Urban land use has more than doubled since 1960; however, land use absorption estimates indicate that total population capacity is double 1980 County population figures. In 1980, total County population was 155,435 individuals, with approximately 86% Caucasian. Age-cohort based demographic forecasts indicate relatively stable 2.1% annual growth rate through 1990. In 1980, total house number in the County was 58,800 with 76% in incorporated areas; median household size was 2.5 persons.

In 1980, the total San Luis Obispo County labor force was 64,600 persons. Approximately 60,000 people of this total were employed, indicating an average annual unemployment rate of 7.1%. Total labor force participation in 1980 was 55.7%, with male participation rate at 65% as compared to 46.5% for females. Government provides 25% of the jobs in the County; State and local education accounts for 50% of government jobs. Tourism is a strong local economy element; therefore, retail trade and services provided 22.5% and 20.9%, respectively, of total jobs. Construction activity provided 11.4% of total jobs, followed by manufacturing at 6.4%, and transportation and public utilities at 5.6%. Finance, insurance, and real estate sectors provided 3.8% of total jobs as compared with agriculture at 3.4%. Wholesale trade was 3.0% of total employment. Mining, including the oil and gas industry, continued as the smallest County industry with 300 jobs because there was no offshore oil and gas production in State and Federal waters offshore of San Luis Obispo County.

Potential offshore oil and gas leasing and development activities along the County coast could result in increases in mining and related industries employment. Accordingly, average wage rate would increase proportionately from increases in direct and indirect oil and gas employment and related local tax subvention revenues. Higher average wage rates characteristic of the oil and gas industry would directly and indirectly influence both level of employment and average wage rate in the County. Educational facilities at California State Polytechnic University in San Luis Obispo have the potential to enhance local employment development in high technology industries. Combined increases could result in a broader local tax base. Effective local tax rate reductions could be realized from increases in the economic export base associated with Federal leasing and development of oil and gas resources.

STUDY PRODUCT(S): ECOS Management Criteria, Inc. 1985. Economic and Demographic Profile of San Luis Obispo County, California. A final report for the U.S. Department of the Interior, Minerals Management Service Pacific OCS Region, Los Angeles, CA. MMS Report 85-0015. Contract No. 14-12-0001-30164. 268 pp.

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Tanner-Cortes Banks	**29079** ***(II)***	**29079.5** ***(II)***	**29080** ***(II)***
	29087 ***(III)***		
Thermal Conductance	**30157** ***(IV)***		
Threatened Species	**29082** ***(III)***	**29090** ***(III)***	**30023** ***(IV)***
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Trace Metals	**29079** ***(II)***	**29079.8** ***(II)***	**29080** ***(II)***
	29080.3 ***(II)***	**29080.8** ***(II)***	**29083** ***(II)***
	29083.4 ***(II)***	**29083.5** ***(II)***	**30032** ***(III)***
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Videotapes	**29087** ***(III)***	**29102** ***(V)***	**29104** ***(III)***
	30032 ***(III)***		
Vulnerability	**29104** ***(III)***		
Water Column	**29079.8** ***(II)***	**29080.2** ***(II)***	**29080.3** ***(II)***
	29080.4 ***(II)***		

Key Word	Access Number *(Section)*
Western Gulf	30050 *(VII)*
Wind Forcing	29113 *(VI)*
Workshop	29122 *(V)*

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